

## New Options in Pediatric Prostheses

Children are not small adults! The prosthetics discipline has long cautioned against trying to adapt adult componentry for use by young patients with congenital or acquired limb deficiencies... for a variety of reasons.

For one thing, patient physiology is patently dissimilar. For another, activity level and demands placed on a prosthesis tend to be more rigorous for children. Finally, the limb loss etiology is typically different, calling for a wholly different management approach. A child's partial or complete limb absence is frequently either present from birth or the outcome of amputation surgery after birth to correct a congenital defect. By comparison, the majority of adult limb losses stem from amputation secondary to peripheral vascular disease, typically occurring in the later years of life.

The physiology, mental and physical capabilities, and emotional character of an otherwise-healthy child compared with that of a diabetic senior citizen are generally as dissimilar as night and day. In the former case, the goal is to enable the child for a lifetime in which he or she can grow and develop more-or-less normally and matriculate into adulthood with as much mobility as possible. In the latter instance, the goal is to restore a reasonable level of function to provide the older patient with an acceptable quality of life in his or her remaining years.

**Junior Solution  
above-knee child  
prosthetic system.**

*Photo courtesy of  
Össur.*

Until recently, prosthetic components designed specifically for younger children have been somewhat hard to come by. In the past most children received a SACH foot, which is adequate for basic ambulation but may be a hindrance for active youngsters. Above-knee patients typically received a simple single-axis knee. During the 1990s, several O&P manufacturers, notably Otto Bock, Seattle Limb Systems and Endolite, came out with some better choices for children, many of which continue to be available today.

Building upon that good start, two other leading manufacturers of prosthetic componentry have released new pediatric product lines in recent months, which significantly expand our options for designing

and delivering rugged, functional prosthetic systems to young, active patients. The remainder of this article will focus on these new products.

### P-POD™

The P-POD™ system from Ohio

Willow Wood has been designed from the ground up. The company's R&D team started with a detailed study how children walk in the various stages of

physical development, then set out to build a line of prosthetic and orthotic components to accommodate the active lifestyle of young patients with mobility challenges.

The first group of P-POD products to be introduced includes a pediatric Alpha® Liner interface, SACH (solid ankle, cushion heel) basic foot, Impulse dynamic-response foot, and a series of growth plates to allow the prosthesis to "grow" with the child.

*Young patient wears  
Alpha P-POD liners.*

*Photo courtesy of Ohio  
Willow Wood.*



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Welcome to the Spring 2004 issue of *First Step*, a professional publication of Gulf Coast Orthotics & Prosthetics. Through this quarterly newsletter, we will endeavor to keep the west Florida rehabilitation community abreast of the latest trends, developments and technology in the management of physically challenged patients.

Gulf Coast O&P prides itself in comprehensive patient care and excellent service. Our practitioners are ABC-certified. Steve Gavin, CPO and owner, is certified in orthotics and prosthetics with more than 15 years' experience working in Australia, Canada and the U.S. Charlie Mata, C.O., who joined Gulf Coast O&P in December 2003, has 14 years' experience in the field, specializing in paediatrics. He has recently returned from volunteer placements in Mexico and Haiti.

We hope you find *First Step* to be a useful resource and welcome your input, referrals and requests for further information. Call us at (850) 477-4880, or contact us through our website at [www.gulfcoastoandp.com](http://www.gulfcoastoandp.com).

# — The Prosthetic Challenge of Phantom

New amputees face various obstacles to regaining lost function with the aid of a prosthetic limb. Many are routinely addressed and resolved. One that isn't at all routine in either occurrence or resolution is phantom limb pain...the conscious perception of a painful limb, even though that limb is no longer present.

Phantom limb sensation, which is not always painful, occurs to some extent in the majority of people with limb loss, and has even been reported among individuals with congenital limb anomalies. Fortunately for many, the sensation of the missing limb still being present—able to function and capable of feeling pain...and sometimes pleasure—fades with time, and the perceived pain, if present at all, tends to be mild...perhaps a burning or cramping feeling.

But for others, the pain can be severe, chronic and debilitating, described by one patient as an intense stabbing pain, by another as if the lost limb were being crushed. For these patients, phantom limb pain is potentially a strong contraindication to prosthetic success.

Phantom limb pain is well studied but not well understood; many theories regarding its etiology have been offered, but none has been judged conclusive. It has become generally accepted that the phantom sensation is not imagined or a result of psychological or emotional disturbance. A widely accepted explanation centers around the *homunculus* or "little man," a neurological map of the body that resides in the brain's sensory cortex. Every actual body part is "wired" to its corresponding "part" in the homunculus. If a body part is lost, as in an amputation, the brain is unable to handle the sudden absence and "rewires its circuits" to compensate for the loss of signals from the missing limb segment.

Other theories implicate injury to nerves during amputation, which cause changes in the working of the central nervous system, and formation of post-surgical neuromas within the residual limb.

Timing of the onset of phantom sensation also varies widely. More often than not, the first experience occurs within a week of amputation surgery; however, some patients do not experience their first awareness of a phantom limb for several months...and some not at all. The condition appears more commonly among older amputees, and those who experienced pain in their limb prior to surgery are more likely to feel pain in a phantom.

Sometimes, the phantom limb appears to continue the deteriorating progression of its actual diseased limb before amputation, e.g. a phantom of a limb paralyzed at the time of amputation that is initially painless but later develops the sensation of contractures.

Phantom pain may be continuous or periodic. Research suggests that pain sensed proximally on the phantom limb to be generally vague and short-lived, while pain experienced distally is more intense and longer-lasting.

Factors that may trigger phantom sensations include:

- Complications during and after surgery.
- Climatic conditions, particularly changes in air pressure and temperature.
- Inactivity, i.e. remaining in a relatively same position for long periods, which can interrupt residual limb blood flow.
- Stress, anxiety or fear.
- Fatigue or insomnia.
- Yawning or sneezing.
- Illness, notably colds, flu, strep throat, infections and viruses.

## Management

The prosthetic implications of phantom limb pain are both varied and interesting. Certainly, major or debilitating pain does not bode well for an amputee's ability to tolerate a prosthesis. On the other hand, it has been reported that the pressures exerted on the residual limb by a prosthetic limb can ameliorate phantom limb sensations.



Photo courtesy of Ohio Willow Wood.

## Preflight Screenings for Amputees

The horrific events of Sept. 11, 2001 have changed many areas of American life, notably air travel.

Because commercial airliners were used as the primary weapons in the 9-11 attacks, airport screening procedures have since become extremely rigorous and comprehensive. Virtually no one who boards an airliner in this country will escape a pass through a metal detector and preflight inspection of carry-on luggage and personal items... including prosthetic limbs, orthopedic braces, canes and crutches.

While some may view close inspection of personal assistive devices as difficult for a physically challenged individual, it's hard to argue with the rationale: Airport screeners have found everything from a bayonet to a handgun concealed in hollowed-out prosthetic limbs. Thus, amputees and others who plan to take an assistive device, regardless of type or construction, with them on a flight should anticipate and allow extra time for a thorough preflight screening.

On its website, [www.tsa.gov](http://www.tsa.gov), the Transportation Safety Admin-

istration (TSA) offers specific guidelines for air travelers who will be carrying or wearing a disability aid. The site explains that screeners will need to see and touch prosthetic devices, casts, or body braces during the screening process, that individuals may request a private screening at any time and be accompanied by a companion or family member (once screened themselves) throughout the process.

The inspection will include an explosive trace detection screening of the device—a swab sample taken from the exterior of the device for analysis. If obtaining the sample will require lifting or removing clothing, the screener should offer a private screening, conducted by two screeners of the same gender as the passenger. Crutches, canes and walkers will be analyzed by x-ray machine.

TSA encourages travelers with disabilities to describe to the screening staff their limitations and type and location of special equipment they are wearing at the beginning of the of the inspection procedure and to ask for any assistance necessary.

# antom Limb Pain —

Certain research also suggests that phantom limb awareness is important to prosthetic success, enabling the amputee to sense where the replacement limb is in space through the intervention of the phantom limb sensation. One patient interviewed for a study even reported that he needed to “wake up” his phantom before he could successfully walk in his prosthetic leg.

Phantom limb pain can be a long-term management problem; specific treatment may be drawn from more than 50 different therapies that have been reported successful in specific instances. A good starting point is to identify and eliminate factors that increase the pain. A patient journal may prove helpful here.

A measure that has proven particularly effective is actually a preventive step: If a candidate for amputation is experiencing significant pain in the limb to be amputated, providing thorough pain relief by regional anesthesia both days prior to surgery and for several days post-op may minimize or preclude phantom limb pain altogether.

Among the various treatments reported successful for some patients are TENS stimulation; biofeedback, hypnosis and relaxation therapy; acupuncture; anticonvulsant and antidepressant drugs and other medications; neuro linguistic programming techniques; nerve blocks, nerve revisions, and surgical revision of the residual limb; and certain neurosurgery procedures.

In general, increased blood flow to the amputated area can help reduce phantom pain. Constant exercise—such as stretching, running, walking, bike-riding or lifting weights—often provides relief. Some prosthetics-related therapies that have helped provide relief for specific patients include:

- Wrapping the residual limb in a heating pad or warm, soft towel to increase circulation.
- Massaging the residual limb. (Stimulation of an intact contralateral limb has also been reported effective in some cases.)
- Mentally exercising the missing limb in the painful area.
- Mentally relaxing the missing limb and residual limb.
- Engaging in mild overall exercise to increase circulation.
- Exercising the residual limb.
- Alternatively tightening and releasing muscles in the residual limb.
- Soaking in a warm bath or hot tub; also, using a shower message or whirlpool on the residual limb.

Fortunately we generally do not see many patients who experience continuing phantom limb pain. When we do, we typically will suggest certain of the foregoing options and carefully review the patient’s prosthesis to check for pressure points or other aspects of the design that may be stimulating residual limb nerves, which in turn can trigger phantom limb sensations. We may then revise the socket or adjust the alignment in an effort to lessen the triggering mechanism(s).

Another treatment option is to provide residual limb covers made of Farabloc, a fabric containing extremely thin stainless steel threads, which looks and feels like linen. Farabloc shields nerve endings from ions and magnetic influences that may irritate nerve ends and cause phantom pain and other forms of physical discomfort.

Our prosthetic staff also stands ready to assist in the pain management of amputees under our care in conjunction with other members of their rehab team. In difficult cases, we may recommend the intervention of a pain specialist as well.

For more information or to discuss the care of a particular patient, contact our office.

## Pediatric Prostheses

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**Liners**—Like its adult counterpart, the P-POD version of the Alpha Liner is constructed of a heat-moldable mineral oil-based gel encased in a protective fabric cover that extends the life of the gel and facilitates insertion of the liner into a prosthetic socket. Alpha P-POD Cushion Liners are ideal for use with pediatric suction sockets, while P-POD Locking Liners accommodate a locking pin for use with sockets incorporating a shuttle lock. Alpha P-POD liners are available in sizes to fit most children and in buff and medium brown colors.

**Feet**—The P-POD SACH foot is a good, inexpensive choice for children in the early stage of gait development. The P-POD Impulse foot is more appropriate for active children who have developed a normal heel-strike-through-toe-off gait progression. With energy storing and returning capability, this dynamic response foot helps propel active child amputees through their busy day. P-POD feet are available in a range of sizes and cosmesis colors. The Impulse is available in selectable levels of toe stiffness.



**P-POD SACH foot and Impulse foot**

*Photo courtesy of Ohio Willow Wood.*

**Growth Kit**—The P-POD growth kit enables prosthetists to lengthen a child’s lower-limb prosthesis as he or she grows. The kit extends a prosthetic limb up to nearly a full inch, prolonging its usefulness by a year or more.



**Iceross  
Junior  
Stabilo  
liner**

*Photo  
courtesy of  
Össur.*

### Junior Solution

Össur literature explains that the company created its Junior Solution product line to reflect the reality that an ordinary child on an ordinary day will expend more energy and place more demands on a prosthesis than any adult, short of an Olympic contender.

The transtibial and transfemoral versions of the system incorporate scaled down (in both size and weight) variations of proven components well-known in the industry—Iceross, Flex-Foot, and Total Knee.

Össur’s goal in creating its pediatric line was to provide a lower-limb prosthesis that is both safe and durable while providing the performance and flexibility to enable child amputees, nominally ages 5 through 12, to realize their unique potential and to be as active and ambitious as any other child.

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# Prosthetic Options for Kids Expanded

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**Liners**—Iceross Junior liners are pediatric versions of the adult silicone interface that protects and helps seal the residual limb within a prosthetic socket. Two variations are offered: the Dermo, providing added cushioning and comfort for limbs with sensitive tissue, and the Stabilo, offering greater stability and control for active young amputees. Both are comfortable and provide enhanced stamina for extra “playing power.”



*Young patient tackles life head-on wearing Impulse high-activity foot.*

*Photo courtesy of Ohio Willow Wood.*

**Ratchet Lock**—The Icelock 700 Series Small is a socket suspension locking device for an Iceross liner fitted with a locking pin. The lock is lightweight and approximately 30 percent smaller than adult locks and is thus ideal for pediatric applications.

**Foot**—The Flex-Foot® Junior is a high-tech, low-profile energy-storing foot particularly designed for children. Its dynamic response features empower active young amputees to give vent to their excess of energy, to play, to compete, and run till they’re breathless.

The layering of the foot’s carbon fiber keel is carefully designed to complement a child’s varied gait: Deflection of the forefoot from mid-stance to toe-off is proportional to the child’s weight and designed to tolerate the high impact levels imposed by youthful exuberance. Finally, the Flex-Foot Junior’s sandal toe design and anatomically correct foot cover provide a cosmetically pleasing appearance that can enhance a child’s self-esteem.

**Knee**—The Total Knee Junior system provides fluid and natural movement and smooth gait control for children with above-knee deficiencies. This lightweight, highly durable joint features an advanced geometric locking design for extra stability and security. The knee offers fluid extension resistance for quick motion, yet flexion

can be controlled to reduce excessive heel rise. An adjustable stance-flex feature acts as a shock absorber, simulating the flexing action that occurs in a normal knee while walking or running. A final feature of this pediatric knee system is its bright, colorful finish, which is attractive to kids.

**Adapters**—The Junior Solution system includes a full range of socket adapters, tubes and pylons especially sized and stressed to complete a pediatric prosthesis.



The introduction of new pediatric components such as these provides ample evidence that the prosthetics discipline no longer approaches the management of children with limb deficiencies as merely a scaled-down version of adult care. The unique needs and capabilities of child amputees call for a completely different approach, and we now have an varied array of specially designed components for that purpose.

We welcome your inquiries, referrals and requests for further information on this developing segment of prosthetics practice.



*Total Knee Junior  
Photo courtesy of Össur.*

## Note to Our Readers

*Mention of specific products in our newsletter neither constitutes endorsement nor implies that we will recommend selection of those 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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**Ohio Willow Wood • Össur**

### First Step

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