The Hinnant Prosthetics Quarterly

Experience Our Road to Prosthetic Excellence

Autumn 2000

Children Are Not Small Adults

Dear Friends,

This issue of our newsletter examines a highly gratifying segment of our practice—providing for the prosthetic needs of children with lower-limb deficiency. In training and practice, our staff has learned, experienced, and come to appreciate the unique challenges, and joys, of initiating or restoring mobility for young people with congenital or acquired lower-limb absence, from infants to adolescents.

Pediatric management is quite different from working with adults. Scaled-down versions of adult components seldom provide the function of which a pediatric patient is capable. Moreover, the overall treatment approach and interaction with patient and family take on a far different character when treating kids. In other words, *children are not small adults.*

We are confident you will find this presentation interesting and hope you will share it with others who may find it beneficial.

— M. Kale Hinnant, C.P., FAAOP

Pediatric Prosthetics

Children with lower-extremity deficit comprise a small but important part of the lower limb-loss population. Their partial or complete limb absence may be the result of a congenital defect that is corrected by amputation after birth, a congenital amputation (i.e. present at birth) through one or more of the long bones, or an acquired amputation resulting from disease or trauma. While many adult limb absences can be traced to a congenital issue or traumatic event, the majority stem from amputation secondary to peripheral vascular disease, typically occurring in later life.

This is but one of the many major incongruities between adult and pediatric limb loss...and one of the major differences in the prosthetic management of these two distinct populations. The physiology, mental and physical capabilities, and emotional character of an otherwise healthy child compared with that of a diabetic senior citizen are typically as dissimilar as night and day.

In the former case, the prosthetic goal is to enable the child for a lifetime in which he or she can grow and develop 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.

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Improving Quality Of Life for Amputees

Hinnant Artificial Limb Co., Inc. has been providing prosthetic services to North and South Carolina for more than 68 years. It is our goal at Hinnant to help every patient attain the best functional outcome possible. We focus on each patient's individual needs to ensure he or she receives the most appropriate prosthesis.

Our staff members are board-certified and our facilities accredited by the American Board for Certification in Orthotics and Prosthetics. We accept assignment from Medicare, Medicaid, Crippled Children's, Vocational Rehabilitation, Veterans Administration and most insurance carriers. We have individualized payment plans for patients who have no insurance. There is never a charge for a written consultation.

We welcome your inquiries and referrals. For more information, call our Charlotte office, 704-375-2587.

Pediatric Prosthetics — Providing Mob

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Family issues and concerns are correspondingly disparate. Whenever possible, prosthetic treatment for children should be determined, prescribed and monitored by a multidisciplinary team including, but not limited to, the surgeon, pediatrician, physical therapist, prosthetist, the patient (if of appropriate age), and family members. A physiatrist, psychologist and social worker may play valuable roles as well.

Etiology

The initial step in developing a prosthetic treatment plan is to gain a full understanding of the cause and character of the limb loss and determine whether surgical intervention is warranted, as is sometimes the case with a congenital *longitudinal* deficiency. The International Standards Organization recently adopted nomenclature to describe the two major types of congenital limb anomalies:

Transverse deficiency—A deficiency in which no distal (i.e. beyond the point of reference) structures exist. In other words, the limb essentially ends at the location of the deficit.

Longitudinal deficiency—A total or partial absence of structure along the long axis of a segment, beyond which normal skeletal elements may exist. An example would be the congenital absence of a tibia with an essentially normal foot. Other longitudinal anomalies include absence of the femur (better known as proximal femoral focal deficiency or PFFD) and absence of the fibula.

Longitudinal defects often present a difficult decision for families. In the absence of a tibia or femur, normal ambulation is all but impossible, even though the structures beyond the defect may appear to develop normally for a time. The need to amputate these extremities to enable prosthetic intervention is often difficult for families to accept.

Factors frequently associated with these anomalies—e.g. underdeveloped adjacent structures, joint instability, limited or excessive range of motion and angulation deformities—also must be evaluated and incorporated into prosthetic design.

Acquired amputations—typically resulting from lawn mower, machinery or vehicular accidents; malignancies; or bacterial infections—are reported with less frequency than congenital limb defects. Because a child with an acquired amputation has experienced life with the now-missing limb, this patient typically feels a great sense of grief, and his or her family a large measure of guilt, over the amputation. Phantom sensations and limb pain further complicate the treatment plan. For this and other reasons, the approach to prosthetic care is quite different for congenital and acquired pediatric patients.

Growth Management

Perhaps the most profound difference between treating adults and children is that the pediatric patient's body structures—most notably the residual limb and contralateral limb—are growing...rapidly so at certain stages, which poses all sorts of challenges to effective fit and function. The child is also growing developmentally, thereby increasing in ability to use more-functional prosthetic componentry. Particularly in the case of infants and toddlers, correct timing of prosthetic application is an essential part of the process.

Growth in the residual portion of an amputated long bone presents distinct complications, which are better avoided, i.e. bony overgrowth (spiking of the bone through the skin surface) and disproportionate growth of the residuum relative to the contralateral limb, resulting in frequent prosthesis revision or replacement during the growth years. Therefore, surgeons generally perform an ankle or knee disarticulation whenever possible, thereby preserving the growth plates and eliminating overgrowth potential. A disarticulation also presents the advantage of maintaining distal condyles, which can be used as a suspension aid.

The downside of a disarticulation is that few components are available to accommodate the long residuum for young patients. As a result, joint incongruities, gait asymmetry and leg length inequality are common, particularly among very young patients. Often these problems resolve as the child grows, because under-developing adjacent structures allow more room in which the prosthetist can work to mirror the length and function of the contralateral limb. However, further surgical intervention may become necessary to stabilize and equalize leg length. If normal growth does occur in the residual limb during childhood, the slightly shortened limb will be ideal for prosthetic fitting in adulthood.

Contrary to the adult dysvascular limb, which reduces in volume after amputation and application of shrinkers and preparatory prostheses, a child's residual limb continues to grow, thus presenting an additional challenge to prosthetic care. Our goal is to accommodate these growth changes without compromising the child's activities or providing a whole new prosthesis every few months.

We can achieve this outcome by ordering prosthetic feet slightly larger than currently indicated, using modular components

bility to the Lower Limb-Deficient Child

in prosthesis construction, and fabricating sockets to fit with multiple sock plies and distal pads, which can be removed as the child grows. Another approach is the multi-layered (onion-skin) socket, which can shed layers as residual limb circumference and length dictate.

Initial Fitting

Ideally, prosthetic management has been planned and provided for in the overall treatment plan and surgery undertaken as necessary to maximize the child's prosthetic potential. Once surgical procedures have been completed, prosthetic fitting and gait training can commence. In general, young children are developmentally ready for a lower-limb prosthesis when they show readiness to pull themselves up or stand. An older child with an acquired amputation should be fitted as soon as possible.

Socket design can be a particular challenge, especially for PFFD limbs and ankle disarticulations. A well-designed pediatric socket should fit well, enable function and allow for the child's growth without having to be replaced every few weeks or months.

One advantage limb-deficient children have over their older-adult counterparts is the relative health of their residual limb soft tissues, resulting in greater tolerance of socket stresses. Complaints of socket pain and stump ulcers are rare.

That resistance to pain can also be a disadvantage, as children put more stress on their manufactured limb than an older patient could tolerate. From both an economic and family acceptance standpoint, a child's prosthetic leg should be as resistant to breakdown as the prosthetist's skill and today's componentry allow.

Initial systems should be simple—a good thing since the availability of manufactured components designed specifically for children is still relatively limited, although improving. Knee units and dynamic-response feet, if appropriate, come later.

Componentry

Until recently, prosthetic components designed specifically for younger children have been hard to come by. Most children received a SACH foot, which is adequate for basic ambulation but a hindrance for active children. Above-knee patients typically received a simple single-axis knee. Fortunately, several manufacturers now provide better choices.

Improved foot systems include an Otto Bock model with an elastic keel, which provides better performance than the typical SACH foot for young patients who are not ready for a dynamic foot. Otto Bock offers a full line of modular components for children.

For older children, a dynamic response foot such as Seattle Limb Systems' Child's Play, is a popular choice. Child's Play has grown into a complete system of lower-limb components including dynamic pylons with a choice of three spring rates to match wearers' weight and activity level. Endolite also offers a lightweight pediatric line.

Pediatric knee systems remain a challenge, largely due to the limited space available between the socket and knee center in which the knee can function. Among promising new products are the Total Knee Small Wonder by Century XXII, Otto Bock 3R65 hydraulic knee, and DAW Industries Pediatric Knee-Disarticulation Knee.

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Prosthetic Timing

While occasional patients clearly show readiness to begin sooner...or later, the following guidelines apply for the majority of young patients:

0-6 months: No functional benefit to prosthesis use.

7-14 months: Typically, the child is ready to stand during this period. This first prosthesis should be very simple in design and use a socket that accommodates rapid linear growth and method of suspension that does not encumber the child.

15-36 months: During this period of rapid growth, the child's prosthesis must grow as well. At various points, this need will require an entirely new prosthesis; however, techniques to lengthen the limb and increase the effective inside socket dimensions can extend prosthesis life to a year or more.

3-6 years: The typical child's activity level at this age makes durability a must. Exoskeletal designs work well as do some newer endoskeletal components. (However, endoskeletal covers do not generally hold up well for active children.) Patients with a deficit at or above the knee level are ready for their first functional knee.

6-12 years: Growth continues, but more slowly. The child desires more function to accommodate new interests and activities. Recently developed dynamic-response feet for children can improve chances for successful entry into soccer, baseball and other sports.

12-18 years: As for all teenagers, adolescence presents its own special challenges. One or two major growth spurts can be expected to prompt major prosthesis revision; moreover, the desire to "fit in" may affect how the teen uses, and exposes, the prosthesis around peers. Cosmesis takes on new importance. Advanced componentry and special designs can be provided to facilitate involvement in competitive sports, outdoor endeavors and water activities. Upon reaching 18, patients have left the issues of childhood behind and are ready for the full range and fitting principles of adult componentry.

Children's Prosthetic Componentry

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Psychological Issues

Although not primarily the province of the prosthetist, the psychological condition of the young patient and his/her family in regard to the limb-deficiency is a key determinant of prosthetic success or failure.

Young children with a congenital deficit will normally not demonstrate any psychological effects, because they've known nothing different. They will attempt to do whatever they see other kids do with the "equipment" at their disposal. Left to their own resources, they are very adaptable—their only limitations are those placed on them by adults.

Children with an acquired amputation, on the other hand, can be expected to mourn their loss and go through stages of anger and resentment before acceptance of their disability. Their ultimate prosthetic success will depend in large part on their ability to resolve this inner turmoil. Unless the amputee is very young, prosthetic intervention should begin as soon as possible; however, the prosthetist and others on the rehab team should be keenly attuned to the child's progress through the grief cycle and time subsequent treatment steps accordingly. Children with a lower-limb deficit should not be expected to perform functions they would not otherwise be developmentally ready for, as family members become frustrated when they fail to see expected progress.

Otto Bock modular prosthesis

Regardless of etiology, it is important that families maintain a positive outlook, as children typically reflect the mental attitude of their parents. If one or both parents express doubt, either overtly or subconsciously, that the child will be successful with the prosthesis, the child may well reject it. Parents must be assisted to move beyond the common guilt feelings that accompany having a child who is not "whole." With wholehearted support from the entire family, a child's chances for successful rehabilitation are remarkably enhanced.

Child's Play system

An Exciting Outlook

From the outset, prosthetic care of a limb-deficient child is an ongoing process, right into adulthood. Continuous follow-up with check-ups at least every 3-4 months is essential until the child reaches full maturity.

As these patients grow—physically, emotionally, and in ability to cope with their disability—they generally develop an enhanced awareness of their body and its changes and special needs that will enhance the quality of their life and the exciting experiences that it holds.

We feel privileged to be a part of that process.

Note to Our Readers

Mention of specific products in our newsletter does not constitute endorsement, nor does it imply that we will select such products for use with any particular patient. We offer this information to enhance professional and individual understanding of the prosthetic discipline and the capabilities of our practice.

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