The Hinnant Prosthetics Quarterly

Experience Our Road to Prosthetic Excellence Spring 2000

Dear Friends:

This issue of our newsletter deals with the No. 1 reason people require the services of a prosthetic facility...and the primary reason Hinnant Prosthetics is in business: vascular insufficiency, most often the result of diabetes.

These articles discuss the prosthetist's perspective on managing diabetic patients and how our role integrates with the combined efforts of the rehabilitation team. We hope you find the information relevant and worthwhile and welcome your comments, referrals and inquiries.

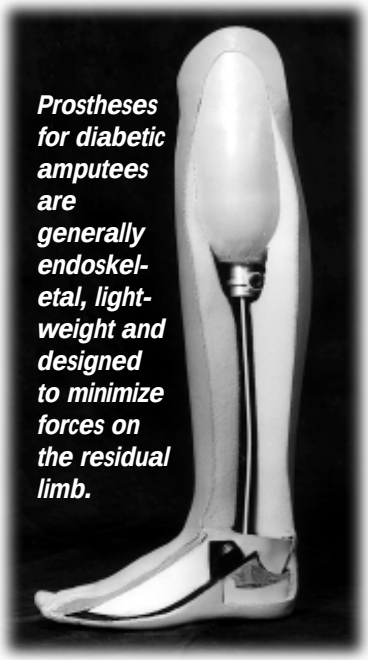
– M. Kale Hinnant, C.P., FAAOP

Prosthetic Implications of Diabetes

The many complications presented by diabetic patients challenge all phases of patient management; prosthetic rehabilitation is no exception.

Our role in serving a diabetic patient may begin with preventive orthotic care to minimize infection potential in dysvascular and/or insensate feet. If, despite all management efforts, a runaway foot infection necessitates amputation, our staff is well-prepared to evaluate and provide the proper prosthetic system for the diabetic amputee's condition and life circumstances.

In particular, our prosthetic care will encompass special efforts to preclude further higher-level or opposite-limb amputations, which frequently follow initial limb removal.



Prostheses for diabetic amputees are generally endoskeletal, lightweight and designed to minimize forces on the residual limb.

Diabetic amputees present the rehabilitation team with the same set of challenges that likely prompted the amputation: ischemia and/or neuropathy in both the amputated and contralateral limb, frequently compounded by a combination of poor muscle strength, coordination and endurance; visual impairment; balance problems; and cognitive difficulty. Some patients simply lack sufficient motivation to walk again after amputation. (See Predicting Functional Outcomes, page 3.)

Prosthetics 2000

Prosthetic Goals

Prosthetic care for a diabetic amputee is generally defined by three specific goals:

(1) Enable the patient to achieve maximum functional restoration in keeping with motivation level and physical capabilities.

(2) Protect the residual limb to avoid further, higher-level amputation.

(3) Provide orthotic management to protect the contralateral limb from infection, which could necessitate another amputation, thereby compounding the prosthetic challenge.

The prosthetic evaluation for a diabetic amputee is more extensive than for most other candidates. Besides the usual attention to tissue viability, muscle strength, endurance, condition of the residual limb, patient motivation and social situation, the prosthetist must factor in potential neuropathy in the residual and/or contralateral limb, cardiovascular limitations, impaired balance, poor proprioception, visual difficulties and mental dysfunction, all common in diabetic patients. The "diabetic haze" that sometimes afflicts these patients can alone preclude prosthetic success.

After surgery, some diabetic patients may be candidates for a rigid dressing with pylon, which offers certain advantages in terms of facilitating early ambulation and controlling residual limb edema. A rigid dressing with pylon may be appropriate for specific diabetic amputees who are likely ambulators. For this population, the foot and pylon may

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When Diabetes Strikes Early

Particlarly Pediatrics

The incidence of children with diabetes who require lower-limb amputation is, fortunately, rare. What is not so fortunate is that the cases that do exist can be every bit as difficult to manage prosthetically as those involving geriatric patients.

Pediatric diabetic patients almost invariably present with Type I (insulin-dependent) diabetes; Type II, appropriately subtitled "adult-onset," diabetes, generally appears in people over age 40. Though Type I diabetes normally can be managed well in childhood, some young patients do go out of control and may develop foot infections that can lead to gangrene and ultimately amputation.

For the prosthetist, the young diabetic amputee presents two sets of challenges: First, if the child's disease has progressed to the point of requiring an amputation, he/she is prone to other complications as well—e.g. vision problems, kidney dysfunction, coordination difficulty, vascular deficiency and skin breakdown—that make learning to use a prosthesis that much more difficult.

Compounding that concern are the usual special problems encountered in prosthetic care of children, notably those involving long bone overgrowth, which can make prosthesis wear increasingly painful and may require surgical revision. Further, as the child grows, the increasing girth of his/her residual limb can outgrow a once-well-fitting socket, a problem seldom encountered with adults.

To prevent pediatric patients from "outgrowing" their prosthesis, the prosthetist can incorporate various design factors, such as an adjustable-length pylon, socket liners, "triple-wall" sockets, socks and distal pads of varying thickness, flexible sockets, and growth-oriented suspension systems.

The need for growth adjustments compounded by the necessity for frequent residual limb examination requires prosthetic follow-up of young diabetic patients every 3-4 months. Particular attention must be devoted to residual limb tissue condition, signs of pressure over bony prominences and length of the prosthesis as compared with the sound side.

Even with adjustments, a new prosthesis will likely be required every 18-24 months with normal skeletal growth.

Hinnant Joins 3 More Prosthetic Networks

Since September 1999, W. T. Hinnant has joined three additional prosthetic and orthotic networks. We are now affiliated with

- Point Health Centers of America (POINT)
- Rehabilitation Associates Network (RAN) and
- Rehabilitation Network Associates (RNA).

These new affiliations further strengthen Hinnant's central position as a provider of prosthetic services in Charlotte and surrounding areas. The extensive credentialing process required for participation in these networks ensures that Hinnant will continue to provide the high level of conscientious care required to meet the needs of both the networks and the community.

We continue to participate in more than 100 national and regional HMO and PPO plans.

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Predicting Functional Outcomes For Older Dysvascular Amputees

The typical new amputee in America in year 2000 is a senior citizen with vascular disease, most commonly secondary to diabetes. The American Diabetes Association reports more than 56,000 diabetic patients will undergo amputation, mostly lower-limb, in the U.S. this year. Calculations using data reported by DeFrang in 1991 reveal that amputation for dysvascular causes occurs in the U.S. every 26 minutes.

While a great many of these surgeries could have been prevented by appropriate patient education and intentional foot care, there is little question that at the time of amputation the limb removal is in fact necessary. However, ascertaining the appropriate direction and degree of rehabilitation efforts after limb removal is frequently challenging, given the costs of management and current morbidity/mortality statistics.

Research Report

For example, Cutson (1996) reported a survival rate of only 50% among dysvascular amputees three years after surgery. Further, unilateral amputees face a 40% risk of losing the contralateral limb within four years. Experience has shown that many geriatric amputees become prosthetic failures, consuming valuable material and professional resources with relatively little corresponding benefit.

In the prevailing climate of cost-consciousness, it has thus become increasingly important to determine a predicted functional outcome for each new amputee before finalizing the rehabilitation plan.

Researchers have found the presence of co-morbidities (see accompanying table) to be a predictor of limited prosthetic success. Chakrabarty (1998) reported that "59% of amputees with peripheral vascular disease, and 54% of amputees with diabetes have three or more (up to five) concurrent medical conditions." A further, well-recognized predictor of a limited functional outcome is self-care dependency existing prior to amputation.

In general, transtibial amputees have been found to function within one functional level of their pre-amputation ability. Negative factors concerning the patient, the residual limb and/or the prosthesis have been shown typically to reduce gait performance by one level. Assessing the quality of the residual limb also helps predict the amputee's functional horizon.

What constitutes a positive outcome? Researchers have determined that frequency of prosthetic use serves as a good indicator of rehabilitation progress, self-care performance and quality of life. The longer the patient uses the prosthesis each day, the better the outcome. Questionnaires and footstep monitors can be used to measure daily activity.

Ideally, determining a dysvascular amputee's predicted outcome is a team effort, involving the personal physician, amputating surgeon, the prosthetist and therapist who will be directing the rehabilitation efforts, the patient, and his/her primary caregiver.

Efforts to predict functional outcome are important to the on-going effort to keep health care costs under control and use precious resources appropriately. At the same time, it is important to give each patient the opportunity to achieve the maximum degree of mobility of which he or she is capable, be it basic or athletic. Impaired mobility has been shown to increase social isolation and emotional dysfunction, while increased prosthetic use typically boosts self-image, physical health and overall quality of life.

Our prosthetic staff is prepared to assist in predicting functional outcomes and developing rehabilitation plans for diabetic and dysvascular patients. Call our office for more information.

Co-Morbidities

Incidence of other risk factors presented by geriatric dysvascular amputees, which may limit their functional outcome:

• Coronary artery disease	44%
• Prior myocardial infarct	33%
• Hypertension	47%
• Cerebral vascular disease	19%
• Prior vascular surgery	39%

Ultimatums

Unfortunately, T.S.'s insurance coverage through Medicaid had lapsed, and the process had to wait for alternative coverage. T.S. went through a two-month wait before obtaining replacement coverage.

During this period, he continued to work long hours on his feet and, because the socket was no longer fitting properly, developed four ulcerations on the residual limb, further delaying the fitting of the new prosthesis. By significantly reducing the amount of time T.S. spent on his feet over the next several months, and through a course of antibiotic treatment, his treatment team was able to heal the ulcers and complete the process for fitting his new prosthesis with no further setbacks.

He is now back to work full-time and enjoying pain-free mobility.

References

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Cutson, TM, Bongiorni DR. Rehabilitation of the older lower limb amputee, a brief review. *J AM Geriatr SOC* 1996; **44**: 1388-1393.

DeFrang, RD, Taylor, LM, Jr. Basic data related to amputations. Ann Vasc Surg 1991; **5**: 202-207.

Managing the Diabetic Amputee

(Continued from page 1)

be added to a rigid dressing at the second or third cast change (2-3 weeks post-op).

Another approach begins with a preparatory prosthesis when the wound has sufficiently healed—usually several weeks post-op.

Based on the patient's results in gait training with the preparatory system or rigid dressing with pylon, the rehab team can determine the predicted functional outcome and the most appropriate selection of components for the definitive prosthesis.

Componentry

Light weight, durability and ease of use are important attributes in all prosthetic applications, but particularly so in lower-limb systems for diabetic patients. The socket interface between the residual limb and prosthesis must not exacerbate ischemic deficiency, and the weight, control and propulsion requirements of the system cannot exceed the strength, coordination and endurance limits of the patient.

The new generation of lightweight, high-strength prosthetic materials—acrylic and epoxy resins, carbon-fibre reinforcements, titanium, aluminum alloys and thermoplastics—are thus excellent choices when creating a prosthesis for a diabetic patient.

Follow-up

Because of the constant challenge presented by their disease, diabetic patients require more-frequent prosthetic management than most other amputees. For example, diabetic amputees frequently experience a reduction in perspiration and loss of skin moisture, leaving the skin prone to breakdown and infection. Thus, regular inspection of the residual limb and adjoining skin surfaces is an important follow-up detail.

Our staff has extensive experience in meeting the many and varied prosthetic challenges posed by diabetic patients.

For additional information, call our office.

Basic transtibial prosthetic systems work well for many diabetic patients.

Key Attributes for a Diabetic Prosthesis

- Light weight
- Minimal energy expenditure
- Durability
- Minimal shear/impact on residual limb
- Simplicity of use
- Ease of donning/doffing
- Capability matched to predicted outcome.

A Diabetic Amputee's Saga of Ulcers and

Fabricating and fitting a prosthesis is rarely a straightforward procedure, particularly when diabetes is a factor. In November 1998, T.S., a 36-year-old diabetic male, underwent a left transtibial amputation after a non-healing foot ulcer became gangrenous.

Upon further exam, T.S.'s "good" (right) foot was found to have a Charcot deformity, (i.e. chronic degeneration of a stress-bearing portion of a joint, with bizarre hypertrophic changes at the periphery. Charcot includes loss of sensation, which leads to relaxation of supporting structures and chronic instability of the joint.)

After his amputation, T.S. was managed with a series of post-operative rigid dressings with a pylon and foot to encourage early ambulation and edema control. The calf musculature of the residual limb was hypertrophied because the patient had favored this limb due to the charcot deformity of the other foot.

Due to the excessive muscle tissue remaining, the initial fitting procedures were not difficult. Because T.S. is a young, active individual, he appreciated the qualities of the Flex-Walk by Flex-Foot. This carbon-fiber foot provides a high level of energy return when compared to most feet on the market constructed of less-resilient materials.

Flex-Walk Prosthetic Foot. (Courtesy Flex-Foot Inc.)

However, the extra soft tissue also contributed to greater daily volume fluctuations of the residuum. T.S. works on his feet all day, and after only a few months his need for prosthetic socks was changing between 8 and 18 plies during the workday.

Also, because T.S. began with a hypertrophied calf muscle, the atrophy of the musculature took place more rapidly and to a greater degree.

This change required that T.S. receive a replacement socket in only five months, rather than the typical 6-12 months, because his residual limb had already become too small for the socket despite numerous adjustments.