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Choosing a foot component for a new prosthetic limb these days is no easy business. Once a simple choice among a handful of distinctly different designs, the broadened selection of a specific ankle-foot mechanism today has become a complex matter requiring knowledge of, and experience with, a steadily growing range now numbering more than 100 foot designs. Without question, “trial-fit” has taken hold in the once-staid prosthetics specialty as well-heeled U.S. and global manufacturers strive to “out-tech” each other to create the latest, greatest artificial leg. When that technology can be translated optimally to a particular individual’s anatomy, lifestyle and personal aspirations, there’s no telling how far the process will take us.

Nevertheless, selecting the “best” foot from the expanding list of contenders can be quite a challenge as time-honored favorites are regularly surpassed in technology, performance, and patient acceptance. It is the prosthetist’s role to remain current on the latest proven products and thereby help the prescribing physician, patient, caregivers, and others involved in the rehabilitation effort understand the benefits and drawbacks of the various feet under consideration.

The ankle-foot component is a critical determinant of prosthetic success. The closer it matches the abilities, environment and activities of the amputee, the better the outcome.

The Health Care Financing Administration’s system of functional levels governing Medicare reimbursement for lower-limb prosthetics (see page 3) provides a convenient framework for categorizing the various ankle-foot options by performance and patient type.

**Level 1 - Household Ambulators**

Amputees in this category tend to be older patients who have undergone amputation due to vascular insufficiency. They generally require safe, basic function and support for moving relatively short distances. The SACH (solid ankle, cushion heel) foot is general-

**Level 2 - Limited Community Ambulators**

Amputees whose functional potential fits in this category can benefit from more durable SACH foot models, non-articulating elastic keel feet, certain multiaxial designs, and feet incorporating lower-level energy-storing characteristics. Non-articulating elastic keel feet provide function similar to a SACH foot but are a bit more flexible, allowing the foot to adjust to varied walking conditions and conform to uneven surfaces.

**Level 3 - Active Community Ambulators**

Amputees within this classification have access to many advanced designs, which are more dynamic, assist toe-off, helping propel the leg into swing phase and reducing energy expenditure. These energy-storing-and-release or dynamic response feet address the needs of Level 3 patients as well. Reflecting its simplicity and comparision to the single-axis design, this foot is frequently selected for preparatory (temporo-)

**Level 4 - High Activity — Child, Active Adult, Athlete**

True Level 4 applications are typically high-tech, high-impact and high-cost. They are also the proving ground where the everyday sys-

Note to Our Readers

Mention of specific products in our newsletter neither constitu-
ent 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 column:

- Bioquest Prosthetics, LLC
- College Park Industries
- Freedom Innovations
- Otto Bock Health Care
- Ortotec
- Prosthetics Today

**Predicting Functional Outcomes**

The U.S. Health Care Financing Administration (HCFA) has established a patient’s functional potential as the primary criterion for determination whether a particular lower-limb prosthetic compo-
nent will be approved for Medicare reimbursement.

An amputee’s predicted functional level, sometimes known as K level, is generally determined by the referring physician and prosthetist, taking into account (1) the patient’s history and (2) current status, including condition of the residual limb and other medical problems; and (3) his or her desire to ambulate.

Level 1: Amputee has the ability to potential or use to ambulate for transfers on level surfaces at a fixed cadence. Typical of the lim-

Level 2: Amputee has the ability or potential for ambulation with various degrees of support, to traverse 4- to 6" curbs, stairs and uneven surfaces. Typical of the unlimited household and limited community ambulator.

Level 3: Amputee has the ability or potential for ambulation with various degrees of support, to traverse 4" curbs, stairs and uneven surfaces. Typical of the community ambulator who has the ability to traverse most environmental barriers, but may have vocational, therapeutic or exercise activity that demands pros-

Level 4: Amputee has the ability or potential for prosthetic ambulation that exceeds basic ambulation skills, exhibiting high impact, stress or energy levels. Typical of the prosthetic demands of the child, active adult or athlete.
Replicating Functions of the Human Foot

The progression of prosthetic foot design throughout history has pursued one overarching objective: To replicate as closely as possible the biomechanical functions of the human foot. With a normal foot incorporating 26 bones, 33 joints and more than 100 muscles, tendons and ligaments, that would seem a nearly impossible task. Nevertheless, as illustrated in the inside pages of this newsletter, we've seen great advances toward that goal in recent years...and the innovation push continues. We'll likely have seen great advances toward that goal in recent years and the innovation push continues. We'll likely never perfectly replace the marvelous natural foot, but we're getting considerably closer.

Among the latest advances is an intriguing new foot concept more than five years in the making. The PerfectStride™ II was engineered around detailed engineering analysis of how the human below-knee complex functions during gait and how existing prosthetic feet measure up in replacing that function. The new design consists of a titanium calf shank and ankle coil coupled to a carbon graphite foot keel, which interact to deliver triplanar reaction to gait forces much as the human foot does.

At heel strike, these components combine to absorb compression shock and store momentum load, which they sequentially return during foot flat, late stance and toe off, propelling the prosthetic limb forward and upward. The foot's creators commissioned gait studies at Stanford University, the University of Southern California and Rancho Los Amigos National Rehabilitation Center, which document that, as compared with other leading prosthetic feet, the PerfectStride™ II is relatively tall build height makes it best-suited for patients with mid-transitibial deficiencies and higher; thus, most lower-extremity amputees may benefit from this design including transfemoral, knee and hip disarticulation, and hemipelvectomy patients. The foot is rated for patients at Functional Levels K3 and K4.

PerfectStride II

What's New

Powered Foot Components

It is somewhat surprising that with powered hand, wrist and elbow components available for upper-limb prostheses for many years, similar technology did not enter the mainstream of lower-limb prosthetics until just 2007 with the introduction of the Proprio™ Foot. Apparently it’s now an idea whose time has come, for another powered foot system is on the near horizon.

The Proprio Foot was named for its ability to mimic the body’s ability to “sense” the foot’s location in space—i.e., proprioception—enabling it to identify inclines and stairs after one step, then position the powered ankle appropriately for succeeding steps. This active ankle motion also allows wearers to sit down or rise from a chair more easily.

The PowerFoot One™, an actively powered prosthetic ankle based on research at MIT’s Media Lab and developed with partial funding from the Veteran’s Administration and U.S. Army, will make its debut in mid-2008. We will address this new foot in a future issue.

Proprio Foot

Is He Too Fast for the Olympics?

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