A-K Amputee Gait Takes Another Step

Computerized knee component, possibly the major prosthetic technology breakthrough of the last decade, has taken another step forward with the introduction of the Rheo Knee™, a microprocessor-controlled swing and stance system that continuously samples and “learns” the user’s gait pattern and optimizes cadence response. The Rheo Knee thus joins the C-Leg and Adaptive Knee in the growing arena of microprocessor-actuated advanced knee component.

The Rheo Knee is an electronic knee with the ability to adapt to each user’s movements in real-time. Through its microprocessor, the knee ‘learns’ the user’s gait pattern and optimizes each step. It is one of the few electronic knees on the market today.

The device automatically adjusts its resistance to the user’s movements in real-time, allowing amputees to negotiate ramps, stairs, and uneven terrain with ease. This is achieved through the use of a magnetorheological fluid actuator, which changes resistance to adapt to the user’s movements.

The Rheo Knee has been designed to provide a smooth, natural gait, reducing the risk of falling or tripping. It features an electronic control system that continuously monitors the user’s movements and adjusts the knee’s resistance accordingly. This allows the user to walk with confidence, even on uneven surfaces.

Unlike conventional hydraulic knee systems, Rheo Knee swing capabilities for amputees in the future. The Rheo name derives from the Greek word for flow, indicating the device’s fluidic nature.

The Rheo Knee is not inexpensive and is definitely not for everyone. Veteran amputees who have worn the Rheo report the welcome experience of walking freely and resistance-free with easy motion and less effort, reducing oxygen consumption and ambulation fatigue, and the ability to walk with confidence on uneven surfaces.

By continually sampling the sensors’ force measurements, the microprocessor is always aware of how the limb is being loaded. Disturbances in the user’s path are readily detected and stance support instantly activated to protect against a potential stumble and fall. The Rheo also provides safeguards against inadvertent stance release. The knee must be fully extended, momentarily still and thereby deliver the proper degree of resistance with each step.

For above-knee amputees, this technology can mean greater security, more natural motion, less ambulation fatigue, and the ability to walk with confidence on uneven surfaces.

Early Prosthetic Management Can Lead to Better Outcomes

Few topics in rehabilitation elicit more debate and exhibit less consensus than the management of patients in the first days after lower-extremity amputation surgery and the timing and method of their transition into a prosthetic limb. This important decision is impacted by the surgeon’s natural desire to closely monitor the new amputee’s recovery and by the surgeon’s desire to expedite the patient’s rehabilitation. A young, traumatic amputee may be capable of taking his first steps a few days after surgery, while an elderly, dysvascular patient may take weeks or months before the clinical team feels comfortable initiating prosthetic care. In some instances, of course, the amputee’s general state of health rules out prosthetic intervention altogether.

In 2003, the American Academy of Orthotists and Prosthetists funded a Clinical Standards of Practice (CSOP) consensus conference on lower-limb post-amputation management. The CSOP concept is used by various medical professionals to examine practice concepts that are poorly or under-reported in the literature.

In an intensive two-day process, the assembled multidisciplinary team of experts reviewed and compared the five predominant post-amputation management strategies:

1. Soft dressings
2. Non-removable rigid dressings
3. Non-removable rigid dressings with an immediate post-operative prosthesis (IPOP)
4. Removable rigid plaster dressings (RRDs), and
5. Prefabricated post-operative prosthetic systems.

The participants concluded that the current level of research does not make possible evidence-based protocols or recommendations favoring one approach over another. However, the CSOP literature review did confirm that rigid dressings do produce significantly accelerated rehabilitation periods and considerably less edema than soft dressings, and that significantly fewer post-operative complications are experienced with prefabricated post-operative prosthetic systems than with soft dressings. Other definitive comparisons are lacking at present.

This CSOP has focused new attention on the benefits and drawbacks of the various approaches and accentuated the need for future research comparing all types of dressings within one study.

We hope you find this First Step issue 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.gulfcoastandp.com.
Moving from Amputation to Ambulation

(Continued from page 1)

### Dressing Options

Exchanging amputation dressing alternatives in more detail:

- **A soft dressing**—soft gauze used alone or in conjunction with a device such as an ACE bandage, shrinker sock, or gel liner to achieve compression and perhaps some form of a knob immobilizer to counter contractures—can be easily removed for wound assessment. However, potential drawbacks impacting early prosthetic interaction are significant: reduced control, edema control, increased risk of contractures, extended immobilization, and depression from being confined to bed for a long period. Prosthetic management may not begin until the third or fourth month after surgery, by which time the patient’s motivation to ambulate may have waned.

- **A rigid dressing** can prevent most of these problems. This dressing is usually constructed of plaster, fiberglass or a combination, and if it is to serve as the foundation of an IPOP incorporates an attachment for the prosthetic components. In addition to controlling edema and preventing contractures, a rigid dressing helps reduce pain and guards against wound contamination.

- By allowing frequent inspection of the amputation site but retaining many benefits of a rigid cast, the **removable rigid dressing (RRD)** offers a compromise between a soft and rigid dressing. The RRD is fabricated of plaster or fiberglass and suspended by stockinette and supracondylar suspension cuff or distal foam cap (bottom). RRDs are particularly useful for patients with uneven residual surfaces, thin residual limb skin, or where a prefabricated dressing would not provide adequate swelling control. Further, the RRD offers the advantage of being able to be removed and reapplied without additional discomfort and time.

### Casting Options

- **A polyethylene semi-rigid dressing (PSRD)** has been applied in place of an initial dressing as early as five days post-surgery. By this time the patient’s motivation to ambulate may not begin until the third or fourth month after surgery, by which time the patient’s motivation to ambulate may have waned.

### Custom Socket Liners Fill in For Difficult Residual Limbs

T he introduction of gel socket liners in the early 1990s opened new vistas of comfort and improved prosthetic suspension for lower-limb amputees and spawned a steady stream of new liner designs and materials, which continues today. Most prosthetic liners are off-the-shelf products of uniform gel thickness throughout and available in various sizes. These products work well for most transfemoral and some transfemoral amputees; however, those with residual limbs that are particularly bony, short, uneven, deeply scarred and whose edema may have waned.

Alpha® DESIGN® custom liners can extend a comfortable, secure prosthetic fit to individuals with one or more of these limb characteristics. These liners are made to conform to the unique variations of a challenging residuum, as modeled by an OMEGA® Tracer® computer-assisted design (CAD) system or a plaster cast of the limb. In the absence of a CAD image, the amputee’s prosthetist can participate in the fabrication of the custom liner through an interactive online consultation with the designer, known as Web Assist. The resulting liner will be one of a kind.

### Custom Liner Helps Defeat Osteomyelitis

A fter almost four decades as a Level 4 (high-activity) amputee, David T., 59, suddenly faced a major curtailment of his activities. A persistent infection in the distal end of his very short (3 inches) transfemoral limb was diagnosed as possible osteomyelitis. If the prescribed antibiotics, or something else, didn’t defeat the infection and attendant swelling, further surgery would be the likely next step.

When your limb is as short as David’s, more residual limb surgery is supposed to be major lifestyle change. Loss of the knee joint would mean having to walk again, with likely ramifications for his miles-a-week running regimen and frequent long-hour days as a county executive. Though already wearing an advanced prosthetic system, David consulted his prosthetist to determine what else could be done.

Gone was the lock pin liner David was wearing. It was allowing considerable movement of his residual limb within the socket. Moreover, despite having little sensation in the distal end of his limb, he was experiencing significant discomfort on the tibia head. Compounding the issue were the significant irregularities—scarring, and bony prominence—on his residual limb resulting from amputation and sutured over by an accident at age 21.

The prosthetic solution was to switch to suction suspension and an Alpha DESIGN custom liner. The new interface produced almost-instant benefits. David noted an immediate pain reduction when wearing his prosthesis, even after having it on for up to 16 hours a day, and limb movement within the socket was all but eliminated. “I asked my wife to try to pull the leg off,” he recalls. “She really tried...and she couldn’t do it.”

With the new liner in place, David’s edema subsided within 10 days, and the infection came under control in 30. “My doctor treated my problem, my prosthetist treated the cause,” he says. He has temporarily traded running for swimming and biking until he can be reasonably confident the infection will not recur.

The remainder of David’s prosthetic system consists of a hybrid PTB (patellar tendon bearing)/hydrostatic socket, Endolite Elite all-terrain foot, and suspension sleeve incorporating a suction valve.
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For above-knee amputees, this technology can mean greater security, more natural motion, less amputation fatigue, and the ability to walk with confidence on uneven surfaces. By continually sampling the sensors’ force measurements, the microprocessor is always aware of how the limb is being loaded. Disturbances in the user’s path are readily detected and stance support instantly activated to protect against a potential stumble and fall. The Rheo also provides safeguards against inadvertent stance release: The knee must be fully extended, momentarily still and achieve 20 percent of the average maximum extension moment during each step to initiate flexion.

The Rheo Knee’s microprocessor-controlled stance feature enables amputees to negotiate a ramp, stairs or uneven terrain with each step. The Rheo Knee, developed by Ossur in conjunction with the Massachusetts Institute of Technology, has won various accolades including the 2005 Frost & Sullivan Technology of the Year Award and inclusion in Fortune Magazine’s 25 Best Products of 2004 and Time Magazine’s Coolest Products of 2004. Like most advanced technology, the Rheo Knee is not inexpensive and definitely not for everyone. However, this new technology promises even greater prosthetic capabilities for amputees in the future.

What’s New

Note to Our Readers

Mention of specific products in our newsletter neither constitutes endorsement nor implies that we will recommend selection of those specific 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 issue: FLO-TECH • Ohio Willow Wood • Ossur

Early Prosthetic Management Can Lead to Better Outcomes

Few topics in rehabilitation elicit more debate and exhibit less consensus than the management of patients in the first days, if not weeks, after lower-extremity amputation surgery and the timing and method of their transition into a prosthetic limb. This important decision is impacted by (1) the surgeon’s natural desire to closely monitor the new amputee’s recovery by regularly examining the progress of wound healing; (2) rehabilitation practitioners’ preference for resuming exercise and initiating weight-bearing and prosthetic intervention as soon as practicable; and (3) reimbursement realities.

Certainly, the age and health of the patient affect the decision. A young, traumatic amputee may be capable of taking his first steps a few days after surgery, while an elderly, dysvascular patient may take weeks or months before the clinical team feels comfortable initiating prosthetic care. In some instances, of course, the amputee’s general state of health rules out prosthetic intervention altogether.

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