

# Leimkuehler ORTHOTIC & PROSTHETIC CENTER, INC.



*Specialists in Prosthetics & Orthotics Since 1948*

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O&P TRENDS & DEVELOPMENTS

SUMMER 2012

## A Granddaughter's Tribute to an O&P Icon

BY EMILY STEWART

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*(Katie Leimkuehler, daughter of Leimkuehler O&P Center President Bill Leimkuehler, recently was spotlighted in a Miami University of Ohio profile, now appearing on the school's alumni website, [www.miamialum.org](http://www.miamialum.org). The article, reprinted here, honors both Katie's accomplishments and the remarkable life of her grandfather, and Bill's dad, O&P pioneer Paul Leimkuehler.)*

Paul E. Leimkuehler's life was seemingly built around his legs. He competed in the 1936 U.S. Olympic Cycling Trials and was the Ohio state cycling champion in 1938. He also thrived on Cleveland-area winters, as the cold weather conditions afforded him the opportunity to speed skate—a sport he was born to do.

Then, like so many others of “the greatest generation,” Leimkuehler went overseas to fight for the Allies in WWII as an Army 2nd lieutenant. But fighting in the Battle of the Bulge, Leimkuehler lost his left leg in a combat injury, and his life changed forever.

What happened next is the basis for *Ski Pioneer*, an original screenplay about Leimkuehler's determination to turn a war tragedy into his life's triumph, written by his granddaughter and Miami alumna Katie Leimkuehler '07.



Despite her B.A. in creative writing and journalism from Miami and MFA in fiction writing from Roosevelt University in Chicago, Katie concedes she never thought she would write a screenplay. She knew she wanted to tell her grandfather's inspiring story but says she had to find the best way to tell it. With an assist from influential people in her life, including her Miami professors and friends, Katie realized the best

vehicle is the big screen.

“My time at Miami shaped the person I am today,” she says. “My friends and professors became supporters of my creative work and helped me grow personally and professionally. “The biggest thing I learned at Miami was how to take an idea and enact it—forming the connection between having a great story



to tell and finding the best way to tell it.”

Her grandfather, also a sought-after speaker, knew how to captivate an audience and leave a lasting impression on them, which is exactly what Katie set out to do in her screenplay. “I've learned from my grandfather that you have to convey emotion through the stories you tell,” she says. “Connecting with the audience and engaging them on a deeper level is what I aim to do, and he taught me that just by the way he lived.”



*(Continued on page 4)*

# Socket Function, Comfort Largely Determine Prosthetic Success

The prosthetic socket, essential point of integration between human tissue and replacement limb, is most often also the place where degree of prosthetic success is defined.

- It is the socket that accepts and transfers to the residual limb the stresses of weight-bearing, suspension and ambulation.
- It is the socket that encompasses and accommodates the often irregular and tender tissues of the residual limb and thereby helps determine how well, and for how long at a time, an amputee can function in the prosthesis.
- It is the socket that can, through intimate and comfortable fit, smoothly deliver the advanced gait performance promised by today's sophisticated upper- and lower-limb prosthetic componentry.

## Prosthetics Today

In other words, a prosthetic limb may incorporate the most sophisticated, technologically advanced and expensive components available, but if the socket does not fit well and allow the residual limb anatomy to function to its capabilities, the result will be less than optimal, the user will not be happy, and the prosthesis may well stay in the closet.

For this reason, our prosthetic staff devotes paramount attention to designing and fabricating the best possible socket for each amputee we serve.

Sockets are as unique as the people who wear them; no two are alike, but certain principles proven to enhance comfort and functionality are built into many current-day designs:

- **Total contact**—Through careful creation and modification of a positive model of the residual limb, our prosthetic team forms the unique optimal socket shape for that individual. For most amputees, our goal is total contact between limb and socket.

A total contact socket enhances venous return, limits edema and reddening/inflammation on the distal end of the anatomic limb, and helps distribute the load somewhat.

• **Total surface bearing**—A total surface weight-bearing socket expands on this concept by distributing forces across the entire residual limb surface. Advantages include reduced pressure on any given limb tissues, better sensory feedback to the user, improved circulation and increased proprioception.

• **Reduced weight**—Lightweight, high-strength sockets enable amputees to do more with less energy expenditure. One way this can be achieved is with a flexible inner socket within a laminated or rigid plastic outer frame. The outer frame covers the primary weight-bearing areas of the residual limb, while pressure-sensitive tissues and bony prominences are encompassed only by the softer inner socket.

• **Transfemoral limb prosthesis**—Lightweight, high-strength sockets enable amputees to do more with less energy expenditure. One way this can be achieved is with a flexible inner socket within a laminated or rigid plastic outer frame. The outer frame covers the primary weight-bearing areas of the residual limb, while pressure-sensitive tissues and bony prominences are encompassed only by the softer inner socket.

We gratefully acknowledge the assistance of the following resources used in compiling this issue: Fillauer Inc., Motion Control Inc., Össur, Otto Bock Health Care, and Willow Wood.



Laminated transtibial socket

### Transtibial Sockets

Today's below-knee sockets are of two primary types: The "old reliable" **patellar tendon-bearing (PTB)** design focuses weight-bearing stress on certain pressure-tolerant structures, such as the patellar tendon and medial tibia flare, and relieves pressure-sensitive areas. The PTB socket is still preferred by many patients, notably those with shorter or bony residual limbs. It generally is not a good choice for patients with residual limb scar tissue and/or chronic skin breakdown.

The principal alternative transtibial design is a **total surface-bearing socket (TSB)** with a gel interface of some type (silicone or polyurethane liner, gel socks, etc.), which spreads the pressure across the entire residual limb surface at a level comfortable for the wearer.

A hydrostatic weight-bearing socket is a specific version of the TSB design, cast in a compression environment to achieve uniform pressure distribution across residual limb tissues. This design encourages



MAS socket

tissue elongation within the liner, increasing padding at the distal residual limb and reducing potential for skin breakdown.

### Transfemoral Sockets

Contemporary above-knee designs typically employ some variety of ischial containment (I.C.) strategy, which has largely replaced the once-common **quadrilateral (quad)** shape. I.C. sockets feature a narrow medial-lateral dimension with the ischium encapsulated within the socket instead of sitting on the brim.

Quad sockets are still applicable for various patients, both for a preparatory prosthesis and as the socket of choice for patients who have worn a quad for many years and do not wish to change.

A particular I.C. design, the Marlo Anatomical Socket®, originally an effort to eliminate the socket brim outline clearly visible under the clothing of female above-knee amputees, also provides increased range of hip motion and may provide added comfort for appropriate patients.



Double wall transfemoral socket  
Courtesy Otto Bock Health Care

### Upper-Extremity Sockets

Upper-extremity prosthetic limbs are controlled by one of two primary methods: body-powered incorporating a harness and control cables, and externally (electrically) powered, typically with myoelectric control. Body-powered systems may be either harness-suspended, in which straps hold the prosthesis close to the body, or self-suspended, wherein the socket must be closely contoured to the residual limb to encompass bony anatomy or maintain suction. In either type, special care in designing and fabricating the socket is essential for maintaining control and suspension throughout the entire range of motion.

Regardless of limb or amputation level, all socket designs have benefits and drawbacks. Discerning and fabricating the best choice for any particular patient is accomplished only after thorough analysis of the individual's physical condition and capabilities, clear understanding of his/her functional goals and careful anatomical measurements.

It's a challenge we welcome every day.



Courtesy Motion Control Inc.

## Suspension—How Prosthetic Limbs Stay Attached

Creating a prosthetic socket involves two major decisions: (1) the design and shape of the socket itself and (2) the method by which the prosthesis is held onto the residual limb, i.e. the suspension.

### Suction Suspension

For appropriate patients, using an atmospheric vacuum to hold the residual limb in the socket can provide a superior outcome. Suction options, whether provided by "pure" suction or a roll-on liner, limit limb movement within the socket and provide the best level of proprioception and greatest range of motion among current suspension methods.

With **pure suction** precise socket fit enables residual limb skin to remain in full contact with the socket wall and thus preserve the vacuum created at donning. Donning typically involves actuating an expulsion valve at the distal end of the socket to evacuate air as the residual limb enters.

Contraindications to suction include bony or irregular residual limb contours, often encountered with transtibial amputation levels; significant residual limb volume fluctuation; residual limb skin challenges; and physical or mental impairment that interferes with donning or removing the socket.

Roll-on **suspension liners** can overcome most of these obstacles, protecting the residual limb from shear forces, providing an easier donning method, and compensating for irregular skin contours. "Cushion" liners can enhance a pure suction suspension and improve amputee comfort; more common are liners incorporating some type of locking device—

**ICEROSS Seal-in transfemoral suction liner** improve amputee comfort; more common are liners incorporating some type of locking device—



Alpha® Hybrid transtibial locking liner  
Courtesy Willow Wood

locking pin and shuttle lock, lanyard or locking strap—to securely attach the liner to the socket.

Prefabricated liners, available in a variety of materials, designs, and sizes, will work for many patients, while custom liners can be created for patients with major residual limb issues or special needs.

Other suction suspension aids include elastic suspension sleeves, which cover the proximal end of a transtibial socket and extend over the knee to the thigh; and vacuum-assist, which sustains the negative pressure in the socket and helps compensate for residual limb volume fluctuations.

### Anatomic Suspension

When suction methods prove unfeasible, suspension utilizing anatomic structures frequently provides a viable alternative, particularly in transtibial and knee disarticulation limbs.

Supracondylar suspension is accomplished by extended medial and lateral socket walls that fully encompass the femoral condyles and a compressible, contoured wedge that fits snugly above and against the medial condyle.

Other anatomic suspension options include constructions that take advantage of congenital protuberances, often involving a cutaway section of the socket and a "door" panel to ease donning and doffing that is applied after the residual limb is in place.



Short transfemoral liner with waist belt  
Courtesy Otto Bock Health Care

### Straps, Belts and Hinges

When suction or anatomical suspension is unavailable, some older suspension methods may be employed. Strap suspension schemes, often used in combination with a waist belt, are relatively easy for the wearer to adjust and therefore are sometimes a good choice for individuals likely to encounter substantial changes in residual limb volume, as in the weeks after amputation surgery.

A suprapatellar cuff, which encircles the thigh over the femoral condyles and attaches to the socket with straps, may be a good choice for transtibial patients who have good knee stability. It is normally used with a waist belt. A thigh corset with metal side joints, may be prescribed for transtibial amputees with a delicate residual limb unable to withstand full weight-bearing loads.

For transfemoral amputees who cannot use suction, a silesian belt, total elastic suspension (TES) belt, or hip joint and pelvic belt may be used for suspending the prosthesis.



Harmony® e-pulse vacuum system  
Courtesy Otto Bock Health Care

## Note to Our Readers

Mention of specific products in our newsletter neither constitutes 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.

## O&P Trends & Developments

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## Granddaughter's Tribute

*(Continued from page 1)*

Ski Pioneer, whose movie trailer was recently submitted to the International Movie Trailer Festival's 2012 Movie Trailer Contest, is a story about the strength of the human resolve in the face of life's toughest challenges. **See the trailer on-line at [www.youtube.com...enter Ski Pioneer in the Search box](http://www.youtube.com...enter Ski Pioneer in the Search box).**

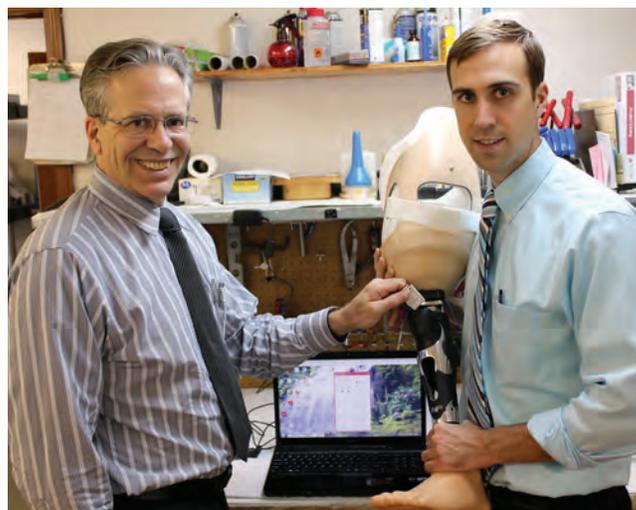
After losing his left leg, Paul became a pioneer for amputees. He created his own artificial leg and started the Leimkuehler Limb Company in 1948. Paul later opened PEL Supply Company, a Cleveland-based prosthetics and orthotics supply company, still owned by his four children.

And he didn't let his amputation deter him from his love of sports, either. Paul taught himself to ski on one leg and even created an outrigger ski pole design for amputee skiers, still used today. This work earned him a place in the National Ski Hall of Fame, the National Disabled Skier Hall of Fame and the Ohio Veterans Hall of Fame—even though he'd never skied before losing his leg.

What could have been a catastrophic situation Paul Leimkuehler turned into an opportunity to learn, to try new things and to open the world's eyes to the power of persevering. It's those lessons Katie has taken with her throughout her own life, even after her grandfather's death in 1993, and they're

the foundation for the central theme she hopes to convey through Ski Pioneer.

"The world isn't always an easy place, and it's our strength in our darkest hours that really defines us," she says. "And that's what I'm trying to show—that the right outlook and attitude can change the worst of situations into positive experiences."



*Paul Leimkuehler II, right, works with dad Bill on a Plié® 2.0, the most responsive microprocessor knee unit yet developed.*

## Paul Leimkuehler II *Big Shoes to Fill*

Paul Leimkuehler II is determined to follow in his father's and grandfather's footsteps—and he has some large shoes to fill.

Now a student at Northwestern University, Paul is currently in the midst of his orthotics residency. He is also working full-time and continuing with his prosthetic studies. He will return to Northwestern in August to finish the hands-on and technical aspects of the program. A second residency is then required for prosthetics. When completed, Paul's pathway to becoming a dual-board certified prosthetist-orthotist (CPO) will have taken approximately five years.

We at Leimkuehler Prosthetic & Orthotic Center see a lot of his grandfather, Paul E. Leimhuehler, in young Paul and are proud of his career choice and progress toward his goal.