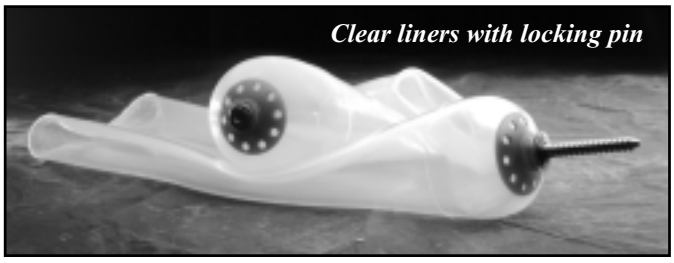
PROSTHETIC & ORTHOTIC UPDATE

Celebrating 37 Years of Excellence

A Publication of Nobbe Orthopedics, Inc. No. 32

Interface Evolution

Latest Generation of Socket Liners Raises Bar for Comfort, Suspension



Clear liners with locking pin

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, deliver the advanced gait performance promised by today's sophisticated limb componentry.

Prosthetics Today

The Socket Interface

The residual limb presents two primary difficulties for creating prosthetic sockets: (1) adequately protecting fragile skin and underlying tissue from vascular insult and breakdown, and (2) compensating for volumetric changes resulting from both progressive postoperative healing and routine daily variation. Irregular, bony residual limbs add to the challenge.

From early-day wooden sockets and woolen socks, we progressed to soft interface inserts to provide added cushioning and protection within the hard outer socket shell. Some of the first inserts were made of a rubber-like material encased in leather. Then in the early '80s, polymer foam liners were introduced, delivering surprising shock-absorbing capability at relatively light weight. Foam liners became a mainstay in socket construction and remain popular today.

While polymer foam inserts made of such products as Pelite, Plastazoate, Nickleplast and Poron have become a common socket interface, *viscoelastic* (gel) products have surpassed them as the interface materials of choice. These materials—predominantly silicones, urethanes and thermoplastic elastomers—offer several desirable characteristics:

• High energy-absorption, providing added protection for bony prominences and other sensitive areas.

• Flexibility—These materials deform easily when stressed, then recover slowly, subjecting limb tissues to less shock, abrasion and surface friction, distributing impact and weight-bearing forces over a wide area, and providing a massaging action that may aid circulation.

• Adhesion—Properly applied, viscoelastic components will create and maintain a negative atmosphere seal about the residual limb surface, producing either full or partial (i.e. in combination with a sleeve, belt or similar device) suction suspension.

(Continued on page 2)

Nobbe Orthopedics Inc. is pleased to announce that it has received a three-year re-accreditation award from the American Board for Certification in Orthotics and Prosthetics (ABC). This award represents the highest level of accreditation in the O&P disciplines. Our practice was recognized in all areas of evaluation including organizational management, professional staff, patient care, quality assurance, facilities and safety management.

Nobbe Orthopedics Inc. has been providing orthotic/prosthetic services in Santa Barbara since 1963 and in Santa Maria since 1994. Our comprehensive fabrication capabilities and throughly trained staff allow provision of all facets of O&P services.

The ABC, a not-for-profit organization headquartered in Alexandria, Va., has provided credentials for practitioners and organizations since 1948.

For additional information about Nobbe Orthopedics Inc. or the ABC, call our offices in Santa Barbara at (805) 687-7508 or Santa Maria at (805) 925-8290.

The Lowdown on Liners

(Continued from page 1)

Viscoelastic materials are now widely used in both custom and prefabricated liners, suspension sleeves, gel-impregnated sheaths and socks, and distal pads for transtibial and transfemoral prostheses, as well as upper-limb systems.

Gel Liners

For people with limb deficiencies, the new generation of gel interfaces means more comfort, improved socket fit and enhanced suspension security. A broad selection of high-quality off-the-shelf gel liners is available in a wide range of sizes. Although seldom necessary today, liners can also be custom-fabricated to accommodate particularly difficult residual limbs.

Besides greater comfort and residual limb protection, the development of gel liners also ushered in a new method of attaching the prosthesis to the residual limb.

"Distal suspension" is accomplished by means of a locking pin, lanyard or other device anchored to the distal end of the liner and mated to an attachment mechanism, such as a shuttle lock, fabricated into the hard socket (see page 3). Increasingly, liners are described as either "locking" (i.e. incorporating a distal attachment plate) or "cushion" (non-locking).

An early drawback of gel liners was difficulty inserting the residual limb into the socket with a liner in place due to surface friction. Initially, powders, lotions and other lubricants were used to facilitate getting into and out of the prosthesis. Then in 1996, Ohio Willow Wood introduced its *Alpha* liner, incorporating an outer fabric layer that slides easily into the socket and provides protection for the gel. That concept has become increasingly popular in such other fabric-covered liners as the *ICEROSS Comfort* from Ossür, *Fabric-Reinforced Easyliner* (ALPS), and *Siloliner* (Silipos).

Recent Developments

Innovation continues. Transtibial and transradial *Aegis* liners from Engineered Silicone Products come preflexed at 45 degrees to accommodate knee or elbow flexion without liner wrinkling, increase joint range of motion and, for lower-limb applications, enable comfortable sitting at 90 degrees of knee flexion.

Another recent improvement, the ALPS *Thermoliner,* combines the precise fit and comfort advantages of a custom-molded liner with the convenience and economy of an off-the-shelf product. This liner is placed over a positive model of the residual limb and heated in an oven for 30 minutes; when it emerges, customization is complete.

Still another significant advancement is the new *Harmony* line from TEC Interface Systems. In response to studies showing that lower-limb prosthesis-wearers lose 6-12% of their residual limb volume in the course of a day, TEC has designed a system to maintain an elevated vacuum between the liner and the socket wall. This vacuum promotes natural fluid exchange and thereby regulates residual limb volume fluctuation. Patients in a sample group wearing a Harmony liner are reported to have lost less than 1% of limb volume during a typical day.

A Few Limitations...

As with most innovations, gel liners present occasional problems. For one thing, they are sometimes not as durable as foam components. Silicone liners punctured, by a sharp fingernail for example, must be replaced from time to time. Generally speaking, these liners can be expected to last a year for moderately active wearers with proper care and cleaning.

Skin reactions can also be a problem for some people. Though medical grade silicone and other materials used in these products are largely chemically neutral and hypoallergenic, patients may experience skin sensitivity or develop a rash if liners are not cleaned properly after each use. We recommend that patients have at least two liners per prosthesis, one to be drying and "resting" on alternate days while the other is being worn.

Gel liners have brought about great change in the prosthetic field. For additional information, please call our office.

A Promising Pinless

The *Summit Lock* by Coyote Design is an innovative new lock suspension method for patients wearing roll-on suspension liners, which offers particular promise for transfemoral and through-knee amputees whose long residual limbs cannot comfortably accommodate a distal lock and those who cannot tolerate the "pull" associated with distal pin lock and lanyard suspension methods.

Wha
Ne

Summit Lock tab attached to liner.

Many amputees simply lack the room for, are unable to tolerate, or have difficulty engaging a distal pin. In these instances, the Summit Lock can provide an excellent alternative.

The lock is mounted proximally rather than distally. Instead of a pin and shuttle lock, this device uses a ski buckle assembly (a tab, or strip, with multiple lock teeth), which is attached to the lateral aspect of the liner at about ischial level. The tab is fed through a hole in the socket and engages in the externally mounted lock. Positioning the tab through the socket wall controls rotation. Mounting the lock externally makes it easy to engage and reduces jamming.

Gel Liners Expand Suspension Options

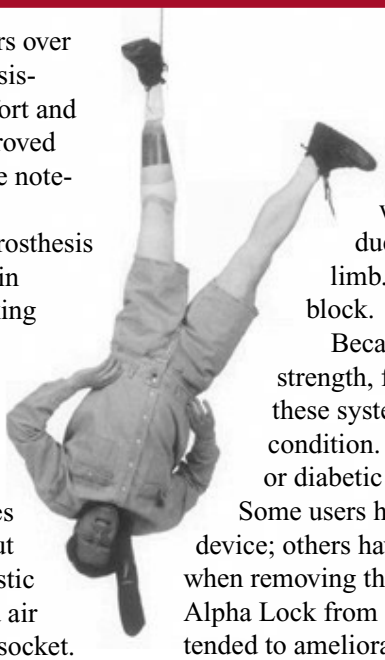
Widespread adoption of viscoelastic gel liners over the last several years has provided prosthesis-wearers a twofold benefit: increased comfort and protection for the residual limb and significantly improved suspension options. Two suspension enhancements are noteworthy:

Locking suspension—Mechanically mating the prosthesis to the end of the residual limb by a serrated locking pin extending from a plate at the end of the liner to a locking device built into the socket. Another option is a lanyard extending from the liner and anchored to the socket. Locking suspension is used extensively with transtibial and upper-limb prostheses, somewhat less with transfemoral systems.

Shuttle lock

Suction suspension utilizes a gel cushion liner (i.e. without locking attachment plate), elastic roll-on suspension sleeve, and air expulsion valve built into the socket.

Opening the valve while donning the prosthesis, then closing it when the liner-covered residual limb is well-seated in the socket creates a secure negative atmosphere within the socket, which is maintained by the suspension sleeve covering the proximal socket and residual limb. Vacuum within the socket holds the liner to the socket wall during swing phase, helping maintain limb volume and limiting tissue compression.



While suction suspension has been used for transfemoral amputees for more than four decades, the development of gel liners has made the method significantly more effective. Before gel liners, patients with a transtibial deficiency were largely unable to use suction suspension, due to bony or sharp prominences in their residual limb. Gel liners have mostly eliminated that roadblock.

Because locking pin suspension requires some strength, flexibility and manual dexterity to use efficiently, these systems work best with patients in good physical condition. They are not always a good choice for geriatric or diabetic patients or people with bilateral deficiencies. Some users have difficulty aligning the pin with the locking device; others have difficulty releasing the lock's release button when removing the prosthesis. The Summit Lock (see below) and Alpha Lock from Ohio Willow Wood are recent innovations intended to ameliorate these drawbacks.

Of course, the time-honored suspension methods—leather cuff, supracondylar-suprapatellar socket brim and wedges for below-knee applications...Silesian band, TES belt and pelvic belt for above-knee patients—are still available and are sometimes used in conjunction with the newer viscoelastic methods.

Long-time patients accustomed to an older suspension method sometimes prefer not to switch to the newer technology. We are prepared to honor their preferences if clinically appropriate.

Locking System

This device is ideal for above-knee amputees of any activity level or weight and can also be used on transtibial amputees looking for alternative suspension methods, notably those whose amputation site cannot tolerate the distal pull associated with other lock systems.

Case in Point

L.P. is a 76-year-old female who underwent a right through-knee amputation due to dysvascularity. At amputation, her surgeon shaved the femoral condyles to create a less-bulbous shape on the distal end of her residuum for cosmetic reasons.

While condyle trimming does produce a less-bulky prosthetic socket, it also can deprive the patient of supracondylar suspension, the most common form of suspension for a through-knee residuum.

Liner on, ready for socket.

Because the thigh portion of a through-knee prosthesis is of maximum length, the resulting prosthetic joint center is actually lower than that of the anatomical center on the patient's sound side. Even with polycentric knee units, which provide an instant center of rotation that more closely approximates the anatomical knee joint level, the thigh component of a through-knee prosthesis inevitably is longer than the shank section. As a result, when sitting, the patient's foot does not rest on the floor.

Lock engaged.

This dilemma would be exacerbated if a shuttle lock were added to the end of a through-knee socket. To avoid this problem, L.P.'s prosthetist selected a Summit Lock for suspension, allowing her to enjoy the benefits of silicone suction without the undesirable and unnecessarily long thigh component that would have resulted from using the standard shuttle lock or even a lanyard design.

Because her right index finger was also amputated for dysvascular reasons, L.P.'s Summit Lock stepped tab was modified with the addition of a dacron strap to facilitate independent donning and doffing.

This patient has made significant progress with her rehab and reports wearing her prosthesis throughout the day.

Down to Cases

R.M., now 73, underwent a right transfemoral amputation at age 69 for dysvascular causes. His clinical team determined that his residual limb would undergo substantial volume changes and thus require a suspension method that would accommodate the anticipated fluctuations.

Initially, R.M.'s prosthesis utilized a silicone suction liner suspension with distal pin and shuttle lock. However, R.M.'s very long residual limb dictated a commensurately long thigh component and shortened shank section with the result that his prosthetic foot did not rest on the floor when he was seated with his knee flexed to 90 degrees.

Inserting lanyard.

When it came time to replace the system a year later, R.M.'s prosthetist set out to provide a different type of suspension that would allow distal pull on the liner without the added length of a pin-and-shuttle lock design, thus allowing a more natural length distribution between the thigh and shank sections.

The option selected was a strap lanyard system, which allowed the patient's fleshy residual limb, enclosed in a silicone liner, to be pulled into the socket by the lanyard, extending through a slot in the bottom of the socket. The lanyard is then anchored to the front of the socket with mating velcro.

R.M. reports the strap makes donning his prosthesis much easier, he is more comfortable sitting with his prosthetic foot on the floor, and the cosmetic result is far more satisfactory.

Securing lanyard to socket.

Making the Right Choices

From the accompanying discussion, it becomes obvious that there is no lack of options available for constructing a socket interface. From this broad spectrum of possibilities, how do we decide what is best for amputee patients?

That's where the knowledge and experience of our board-certified prosthetic staff make a big difference.

Every amputee, every residual limb, presents a new situation... a new challenge. Each patient brings his or her own circumstances, lifestyle and expectations into our office. Our role is to provide the best, most practical substitute limb we can create to achieve the best possible outcome.

Some patients do well with the basic hard socket and wool sock routinely provided 25 years ago. Others present with an extremely difficult residual limb or other complications that require the most up-to-date protective interface we can provide. No standard recipe will work in this business...each limb we create is unique.

Our prosthetic staff thoroughly evaluates each new patient—physically, biomechanically and personally—before embarking on a limb design. We encourage physician, therapist and family participation in that process.

Note to Our Readers

Mention of specific products in our newsletter neither constitutes endorsement nor implies that we will recommend selection of such products for use with any particular patient or application. We offer this information to enhance professional and individual understanding of the prosthetic and orthotic disciplines and the experience and capabilities of our practice.

We acknowledge the assistance of the following resources in compiling and illustrating this issue:

ALPS South • Fillauer Inc. • Ohio Willow Wood
Ossür • Silipos • TEC Interface Systems

Nobbe Orthopedics, Inc.
3010 State St. • Santa Barbara, CA 93105

PROSTHETIC & ORTHOTIC UPDATE

A Publication of
Nobbe Orthopedics, Inc.

3010 State Street
Santa Barbara, CA 93105
(805) 687-7508
FAX (805) 687-6251

203 East Fesler
Santa Maria, CA 93454
(805) 925-8290
FAX (805) 346-8713