

We're moving — Spring 2008



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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.

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Houston (713) 747-4171 • Stafford – (281) 980-5300 • The Woodlands – (281) 419-6638 • www.dynamicoandp.com

7015 Alameda Road
Houston, Texas 77054

4915 South Main, Suite 115
Southwest Professional Bldg.
Stafford, Texas 77477

Southwood Tower
19221 I-45 North, Suite 480
The Woodlands, Texas 77385

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L.P.

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DYNAMIC ORTHOTICS and PROSTHETICS

Suction? Liner? Belt?

Suspension Choice a Key Determinant of Prosthetic Success

When referring to prosthetics, the term “suspension” derives from a primary definition of its root word suspend...“to hang from somewhere.”

In fact, that definition reveals the primary challenge of attaching a replacement limb to the human anatomy: Hanging from a residual limb, the prosthesis is subject to gravity, which applies a distal force, pulling the replacement limb away from the body. In lower-limb applications, this displacement occurs primarily during swing phase. This movement is reversed during stance phase as the patient’s weight and momentum push the residual limb down into the socket. The resultant movement of the prosthesis on the residuum during ambulation is known as pistoning, a process that significantly hampers prosthetic performance through suboptimal gait, increased energy expenditure, fatigue, discomfort, skin breakdown, and safety risks.

Prosthetic science has made great strides in recent years at minimizing pistoning through improved suspension methods and socket designs. Finding the right suspension option for any given patient is often the pre-eminent factor in achieving prosthetic success.

Note: At this point, we should observe that virtually all suspension methods currently in use in the United States involve a prosthetic socket. There is great promise, however, for a new method of attachment currently being investigated in other parts of the world involving direct attachment of

a limb prosthesis to the residual bone through osseointegration. We will explore that topic in detail in a future newsletter.

Suction Suspension

For appropriate patients, suspension methods utilizing an atmospheric vacuum to hold the socket against the residual limb provide the best outcomes. Suction options—whether provided by “pure” suction, or some type of vacuum assist, limit pistoning improve proprioception and provide the greatest range of motion of all current suspension methods.

With pure suction, a precise socket fit enables the tissues of the residual limb skin to remain in total contact with the socket wall, thereby maintaining the vacuum created at donning. Success with pure suction requires that the wearer consistently be able to don and doff the prosthesis properly. Donning typically involves actuating an expulsion valve at the distal end of the socket to evacuate air as the residual limb enters. A “pull sock” or lubricating agent may be used to assist the donning process, and a vacuum pump may be employed to enhance the suction once the residual limb is established in the socket.

Contraindications to successful suction use may include bony or irregular residual limb contours; significant residual limb volume fluctuation; residual limb skin challenges; and physical or mental impairment that will interfere with donning and creating the needed suction or with removing the socket.

Suspension Liners – A roll-on suspension liner can often overcome many of these

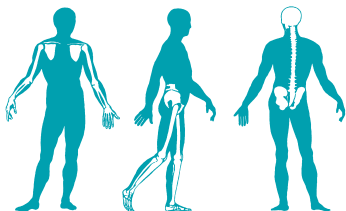
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**Transfemoral
suction socket**
Courtesy: Otto Bock
Health Care



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If your organization would be interested in an in-service on prosthetics and/or orthotic care, please contact company President, Tom DiBello at (713) 747-4171.

Suspension (Continued)

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. In other applications, liners may incorporate some type of locking device, such as a locking pin and shuttle lock, lanyard or locking strap – to securely attach the liner to the socket. The liner is, in turn, attached to the tissues of the limb through the tackiness of the liner material.

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 special considerations. Innovation continues to produce variations in liner designs and materials.

Other suction suspension aids include hypobaric socks, which incorporate a gel band to maintain the seal between the skin and socket wall; elastic suspension sleeves, which cover the proximal end of a transtibial socket and extend over the knee to the thigh; and elevated vacuum units, which sustain the negative pressure in the socket and helps compensate for residual limb volume fluctuations.

Anatomic Suspension
Historically, suspension of the prosthesis was commonly obtained through socket modifications that gripped anatomical structures of the limb. More modern suspension techniques have proven to be much more efficient. However, anatomic suspension is still occasionally utilized as a secondary suspension mechanism or to provide additional support to the structures of the limb.



Short transfemoral liner with lateral locking strap and auxiliary waist belt
Courtesy: Otto Bock Health Care

Supracondylar suspension of the transtibial prosthesis 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. The wedge can either be fabricated into the proximal socket wall or molded into a soft socket insert. While supracondylar modifications are only moderately successful in

suspending a prosthetic limb, by crossing the knee joint proximally, they serve to stabilize this joint and are of particular value in treating patients with shorter residual limbs or ligamentous laxity of the knee capsule.

Other anatomic suspension options include constructions that take advantage of congenital protuberances. For example, adequate purchase can often be obtained against the malleoli in Symes amputations and against the condyles in knee disarticulation amputations. These sockets may involve a cutaway window for donning and a "door" panel that is applied after the residual limb is in place or various socket inserts that are placed around the limb prior to the donning of the socket.

Straps, Belts and Hinges

When suction or anatomical suspension is unavailable for various reasons, some older



Patellar tendon-bearing socket with supracondylar suspension

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. However, strap methods allow significant pistoning and are generally not as comfortable as other suspension types.

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.



Courtesy: Otto Bock Health Care

Upper-Limb Suspension

Suspension methods for upper-extremity prostheses, both body-powered and externally powered (myoelectric), are in many ways similar to those for a lower-limb system: They may utilize suction, intimate fit around anatomic structures, a liner, one of several tried-and-true harness suspension methods, or a combination of these.

The figure 8 harness, chest strap harness, and shoulder saddle harness remain typical methods for suspending upper-limb prosthesis. Harness systems are generally easy to don and remove but can significantly restrict range of motion, and strap chafing is common, as well as excessive pressure in the arm pit of the sound side.

Pure suction, where applicable, can provide excellent suspension and is a desirable choice for an externally powered system that does not require a harness for body control. Upper-limb suction sockets require some skill to don and generally stable residual limb volume. Pure suction tends to be more appropriate for above-elbow deficiencies.

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WalkAide: A major step forward in the treatment of foot drop

Walkaide is a medical device that, after more than a decade in development, has received marketing clearance from the FDA for improving the walking ability of people experiencing foot drop.

Developed by a team of researchers at a major university, WalkAide simulates the typical nerve-to-muscle signals in the leg and foot, which causes the foot to lift at the appropriate time in the walking cycle. This results in a smoother, more natural, and safer stepping motion.

Customized for your patients walking pattern

WalkAide is not a one size fits all device. Rather, a specially trained medical professional is required to fit and customize WalkAide for you. Using Walk Analyst, a multifaceted computer software program, the clinician will tailor WalkAide to your individual walking pattern for optimal effectiveness.

Talk to your patients to see if they might be interested in Walkaide

A sophisticated medical device, WalkAide

uses advanced sensor technology to analyze the movement of your leg and foot. It then sends electrical signals to peroneal nerve, which controls movement in your ankle and foot. These gentle, electrical pulses prompt the muscles to raise your foot at the appropriate time.

Although highly-advanced, WalkAide is surprisingly small and discreet, and quite easy to use. It consists of a battery-operated, single-channel electrical stimulator, two electrodes, and electrode leads.

Muscle therapy exercise mode at home

WalkAide is an all-inclusive device with a pre-programmable exercise mode that allows you to exercise your muscles while resting for a set period of time as prescribed by your doctor.

On August 17, 2007 all of our clinicians have become certified to dispense Walkaide, so if you would like a free evaluation, please call and schedule an appointment at (713) 747-4171.



Photos Courtesy: WalkAide

Suspension (Continued)

Gel liners can be used for both above- and below-elbow systems and function mostly like lower-limb liners; in fact, it was not until recently that liners designed specifically for upper-limb applications have been offered. A pin and shuttle lock may be used for

short-to-medium transhumeral and transradial limbs, while a lanyard system is generally indicated for long transradial and wrist disarticulation levels.

Various transradial and wrist disarticulation socket designs incorporate anatomic suspension utilizing the humeral epicondyles or the styloids of the wrist.

The best-known of these is the Muenster socket for short transradial deficiencies. Determining, designing, and creating the most effective suspension method for any prosthetic patient is a role properly reserved for the well-experienced, board-certified.

We welcome your inquiries and referrals.

Warrior (Continued)

veterans. These opportunities, including transportation, lodging, adaptive equipment and individualized instruction in various winter and summer sports, are provided free of charge for wounded warriors and their families. The program recently was expanded to include outdoor sports including hunting, fishing, archery, boating and camping, through which participants learn hobbies they can enjoy with friends and family without the need for special equipment or ongoing training.

These activities play an important role in a wounded service member's recovery. Typically war amputees go through a difficult adjustment period. Most are in their 20s and accustomed to

being active, involved and in charge of their life and body. The sudden traumatic change in physical ability makes them vulnerable to psychological, emotional and physical trauma, which severely impacting both the returning soldiers and their families. Participation in WWP sports programs shows wounded warriors the promise of a bright and active future and provides a foundation for the development of a positive self-image.

The Wounded Warrior Project provides a way for a grateful nation to thank its wounded servicemen and women for their sacrifice. Details can be found at woundedwarriorproject.org

Recovering Wounded Warrior participates in annual Hartford Ski Spectacular event for people with disabilities.

Courtesy Wounded Warrior Project



The Latest in Prosthetic Liners

Gel liners, sometimes known as roll-on suction sockets, aren't particularly new anymore – they've been a part of mainstream

prosthetic practice going on two decades, and increasing numbers of amputee patients are wearing them.

That growing history doesn't mean the innovation is over, however. In reality, new interface designs are coming to market at a rapid rate, giving prosthetic patients new possibilities for comfort, function, prosthetic endurance and quality of life.

One recently introduced concept combines the advantages of a cushion liner with those of a hypobaric sock to provide reliable suction suspension without an external sleeve. **IceroSS® Seal-in Liners** incorporate a circumferential sealing membrane™, which conforms to the inner socket wall and maintains secure suction suspension, even if the wearer's residual limb volume changes during the day. Benefits for appropriate patients include more reliable suction suspension, increased range of motion, and increased comfort and endurance.

Also new is a liner designed specifically for upper-extremity applications. Previously, liners prescribed for upper-limb amputees were in reality lower-limb products of an appropriate size for the patient's residual arm.

The Alpha® Upper-Extremity Liner retains the attributes of its lower-limb cousin but features a unique oval-shaped umbrella that better matches



Custom silicone liners
Courtesy: Otto Bock Health Care

the upper limb shape and allows for a more comfortable fit. It is available in three prefabricated sizes as well as custom versions for challenging limb shapes and conditions.

A **custom liner** most always gives amputees the best fit and performance and is particularly recommended for limbs with sharp or irregular contours, a high level of sensitivity and/or significant scarring. The central ingredient of custom liners may be silicone, urethane or thermoplastic elastomer; each offers specific properties and advantages, which are evaluated by our prosthetic team in relation

to each patient's needs.

More and more liners are being provided with an outer fabric layer, which serves to facilitate the donning process and extend the life of the liner.

Another significant new advancement in interface technology is the **IceroSS Synergy**, a liner incorporating two distinct silicone gel layers—a soft inner layer designed to soothe and protect the residual limb and a firm

outer layer to maintain liner stability during active wear. This product also features a reinforced fabric built into the distal end to provide additional protection to the end of the residual limb and limit longitudinal stretching and therefore undesirable liner movement on the residual limb (pistoning).

An optional feature of the Synergy liner is a new type of outer covering called the Wave feature, designed to make the liner easier to bend at

the knee for transtibial amputees and thereby better able to adapt to the wearer's movements. During knee flexion, Wave liners exhibit less bunching at the knee posterior and more elasticity anteriorly and posteriorly, which combine to deliver greater freedom of movement.

A final development worth noting is the creation of conical liners for transfemoral amputees. By more closely conforming to the anatomy of patients with a distinctly conical residual limb shape, these liners may eliminate the need for auxiliary belts, straps and/or suspension sleeves.

For more information on these and other recent liner advances, we invite you to contact our office.



Transfemoral Seal-in Liner for conical limbs
Courtesy: Össur



Custom urethane liner
Courtesy: Otto Bock Health Care



Alpha upper extremity liners
Courtesy: Ohio Willow Wood



Synergy liner with Wave feature
Courtesy: Össur

The Greatest Casualty Is Being Forgotten

A sad reality of the Global War on Terror (GWOT) is that many American soldier-heroes are coming home with battle wounds, some involving the loss of a limb. While the medical and rehabilitative care provided by the federal government is excellent, often involving state-of-the-art prostheses, there's only so much a hospital care team can do for a young, recently vital soldier whose unlimited life possibilities have suddenly been compromised by a sniper's bullet or improvised explosive device (IED).

That's where the **Wounded Warrior Project (WWP)** steps in to make a difference by helping servicemen and women heal both physically and mentally and making sure they do not feel abandoned.

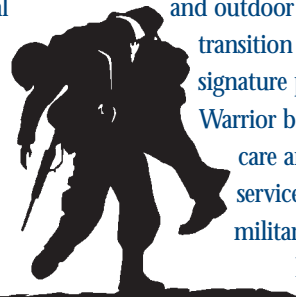
Soon after war casualties began returning from Iraq and Afghanistan, some other military veterans realized that these wounded men and

women had special needs beyond medical care. They founded WWP to bring comfort and support to wounded service personnel and their families in the transition from the hospital bed to independent and productive lives.

WWP programs encompass in-hospital support, benefits counseling, advocacy, adaptive and outdoor sports, mentoring and work transition assistance. The organization's signature program is the Wounded Warrior backpack, providing essential care and comfort items to wounded servicemen and women arriving at military trauma centers to make their hospitalization more bearable.

The Wounded Warrior Disabled Sports Project, a partnership between WWP and Disabled Sports USA, provides year-round sports activities for recovering amputees and other severely wounded war

See **Warrior** Page 5



WOUNDED WARRIOR PROJECT

Keeping Suspension Simple

In their on-going search for more precise and functional ways of replicating the function of the human limb, prosthetic practitioners regularly evaluate new ideas and technology that may provide better functional outcomes for their patients.

The Keep It Simple Suspension (KISS) system provides a potentially better method of suspension for patients with a transfemoral deficiency, notably those who encounter difficulty donning their prosthesis. KISS components include a roll-on locking liner configured with distal and proximal attachment straps (photo 1) and socket fabricated with openings in the distal end and lateral side. The accompanying series of photos demonstrates how the system works.

In donning the prosthesis (either standing or sitting), the patient rolls the locking liner onto the residual limb in the usual manner (photo 2), advances the distal liner strap through the opening in the end of the socket (photo 3), feeds the lateral liner strap through the lateral socket opening (photo 4) while sliding the residual limb into the socket opening, inserts the distal strap into a D-ring sewn into the lateral strap (photo 5) and through pulley action, seats the residual limb fully in the socket by pulling down on the distal strap. The patient then affixes the strap to a Velcro attachment on the socket's distal exterior (photo 6).

The KISS attachment method has been demonstrated to virtually eliminate pistoning and distal draw and minimize rotation, even in the presence of volume loss.



Photos courtesy KISS Technologies, LLC