Trans-femoral (Above-Knee) Prosthesis

This pamphlet provides trans-femoral amputees with information generally provided to them orally by their prosthetist. Given to the patient at the first appointment, it contains information on what to expect at each of the appointments, how to put on and take off the prosthetic device, how to care for the residual limb (stump), how to practice good hygiene, and what to do in the event that warning signs appear.

Under the proper care and with the support of prosthetic devices, amputees can achieve a high level of freedom and independence. At Ballert we are committed to providing you the highest quality appliances coupled with the best practitioner care available today. Ballert uses only licensed, ABC-certified prosthetists for the casting and fitting of the prosthesis, and for follow-up care. To receive certification, prosthetists are required to complete a postgraduate course in prosthetics and a residency program prior to being allowed to sit for certification exams and becoming certified.

Immediately Following Surgery
During the days following your amputation it is normal to feel a range of emotions because of the loss of your leg and to wonder how you will be able to get on with your life. You can be sure that all new amputees share these feelings of loss and sadness. However, these feelings of sadness or depression are usually followed by the need to resume your normal activity and developing the will to do so. During your recovery and rehabilitation it is important to set realistic goals for yourself. Immediately following your surgery these may include:

- Preventing muscle and joint tightness or contractures;
- Learning to control swelling or shrinking;
- Learning to walk using crutches or a walker; and
- Beginning a hip exercise program emphasizing hip abduction and extension.
Preparatory Prosthesis

Once your residual limb begins to heal, your physician is likely to prescribe a preparatory (temporary) prosthesis. The early fitting of an trans-femoral prosthesis can offer you a positive alternative to crutch walking or using a walker or wheelchair as your residual limb heals. To allow the limb to heal fully and to reduce most of the swelling, a preparatory prosthesis is usually worn for 3-6 months. During this time you will learn how to evaluate and adjust the fit of your prosthesis.

A preparatory prosthesis typically is designed to be strong, lightweight and adjustable. Therefore, the prosthesis might not look like a natural leg. The design allows the prosthettist to easily adjust the alignment (relationship of the prosthetic components) as your walking improves. This construction also lowers your rehabilitation expenses. The preparatory prosthesis is designed to accomplish the goals of early ambulation (walking); shrinking and shaping of your residual limb; and achieving alignment of your prosthetic components.

Early ambulation helps to shrink and reduce the volume of your residual limb. It also enables you to move about and to regain your independence. It also helps reestablish balance, requires deep breathing, which can prevent lung complications, and encourages circulation which can reduce the chances of peripheral clotting known as embolism.

Shrinking and Shaping

Swelling is reduced by containing the limb within a well-fitted socket and through the muscular pumping action created by walking. Because early gait training will result in the shrinking of your residual limb, special suspension systems may be used in your preparatory prosthesis to allow for these changes. Often a preparatory prosthesis will utilize a waist belt or elastic suspension belt (Fig. 1). Gel or silicone liners with pin suspension may be used if large volume losses are not anticipated. As the shrinking and shaping of your residual limb progress, you may wear prothetic socks to fill the empty space left in the socket of the prosthesis. It often takes months rather than weeks to reduce the swelling following surgery. Therefore, whenever your prosthesis is off, your compression device should be worn. This will reduce the limb size as quickly as possible and help control swelling.

Achieving Alignment

The preparatory prosthesis is designed so that the prosthetist can easily change the alignment and/or the relationship of the prosthetic components (socket, knee and foot). This relationship will greatly affect your comfort and the amount of energy you need to expend to walk. The socket is the part of the prosthesis into which your residual limb fits. Your prosthetist will rely on your feedback about the comfort of the fit of the socket, so communicate clearly. Once you have been fitted with a socket, the other parts will be added, and early gait training (walking) can begin. You may add prothetic socks to secure the fit of the socket as your residual limb changes in shape and size.

Trans-tibial amputees often look to their physical therapist (PT) for assistance in learning how to use their preparatory prosthesis. Since learning to walk again requires some weeks, amputees may continue to see their PT throughout the first few months. If a question or a problem arises, these may be addressed and changes made during regularly scheduled visits with your prosthetist.

Definitive Prosthesis

After most of the shrinking has occurred in your residual limb, your physician will prescribe a definitive or long-term prosthesis. You will typically need a new definitive prosthesis every 3-5 years.
There are two primary types of design for a definitive prosthesis.

**Exoskeletal** designs include a hard shell often made of laminate or fiber reinforced plastic. This shell of “skin” is rigid and durable (Fig. 2). This type of prosthesis is not readily adjustable after it has been finished. Its primary advantage is durability and its ability to transfer the weight from the socket to the foot. The acrylic lamination often used for the prosthetic shell allows a high-impact surface with excellent load bearing capabilities. When an amputee requires great durability in a prosthesis, such as that needed for farming or other element-involving or heavy-duty occupations, an exoskeletal design may be a good choice.

**Endoskeletal/Modular** designs include an anatomically-shaped, soft foam cover designed to look and feel like skin (Fig. 3). This soft material covers the internal structure of the prosthesis and is removable to allow the prosthetist to make adjustments and changes to the prosthetic system when necessary. Connectors with an aluminum, titanium or carbon pylon (tube) connect the socket with the foot. The soft covering on an endoskeletal prosthesis is somewhat fragile and requires careful attention to prevent damage. The primary advantages of this design are that it is adjustable and lightweight. In addition, most of the technologically-advanced knees are compatible with endoskeletal designs.

There are four main parts to any trans-tibial prosthesis: prosthetic interface (socket), suspension system, knee and foot.

**Prosthetic Interface.** The prosthetic interface is the part of the prosthesis into which your residual limb fits. It is the interface between the residual limb and the prosthesis. Each socket designed by your prosthetist represents a particular amputee’s needs and the prosthetist’s efforts to treat those needs. Sockets may be hard or soft and can be made from one of many different materials. In addition, the socket may include a liner of foam, leather, silicone or other materials.

Sockets must fit intimately to be comfortable and your prosthetist may use a check socket made from a clear material to evaluate the socket fit before actually producing the socket for your definitive prosthesis. There are two basic socket designs for trans-tibial amputees:

**Ischial Containment Sockets** may be rigid or flexible and can be made in a variety of shapes. They are designed to contain the pelvis inside the socket, providing a bony lock for additional stability. In general, ischial containment sockets have a larger dimension front to back and a narrower dimension from side to side than the quadrilateral socket.

**Quadrilateral Sockets** have four sides and are designed to maintain the pelvis on the brim. They have a larger dimension side to side and a narrower dimension from front to back than the ischial containment sockets. With the quadrilateral socket, there is a shelf for the pelvis to sit on.

**Suspension System.** A suspension system holds the socket on your residual limb and may include a Silesian bandage (Fig. 4), a pelvic band with a joint (Fig. 4), a suspension sleeve, suction suspension sleeve, or suction valve. Sometimes a prosthesis will use more than one suspension method. There are certain criteria for the use of a specific system, and patient preference can also play a role. In general, the use of a belt is not necessary when fitting a prosthesis to a long residual limb.

Suction is the most desired suspension system because of the intimate fit and is typically suited to a longer
residual limb (Fig. 5). Sleeker suspension options, such as silicone sleeves with pins, are available for residual limbs which have healed and for which most of the changes in shape and volume have occurred (Fig. 5). Each suspension system has advantages and disadvantages that your prosthetist will consider when choosing the right one for you.

**Knee.** The knee allows the prosthesis to bend while you are standing on the foot and when taking a step forward. Prosthetic knees are designed to avoid buckling while standing and to allow the artificial leg to be advanced normally at will. Special designs can allow you to walk on uneven ground or to run and change speeds. Typically younger and more active amputees wear these knees. Your prosthetist will discuss your activity level with you to allow special options to be included in the design of your prosthesis.

If you have a relatively short residual limb, you will not have as much hip extension muscle control and will require a “safer” design. Your physician may prescribe a weight-activated locking knee (safety knee) which will lock when you step on your foot and then release to allow the knee to swing when advancing the prosthesis forward.

Advanced systems are available for amputees who wish to run. Swing phase control systems can include either pneumatic or hydraulic control systems to enable the wearer to run or vary walking speeds (Fig. 6).

Newer “high-tech” knees include those with microprocessors which are adjustable throughout the life of the prosthesis, often using computer software to alter them. Other lightweight knee frames include those made of graphite, which house small adjustable knee control units.

**Foot.** The prosthetic foot provides the necessary support to keep the knee stable while you stand on the prosthesis. There are a variety of types of prosthetic feet (Fig. 7).

For many years the standard foot was the Sach foot, pronounced “SATCH” which stands for Solid Ankle Cushion Heel. As the name implies, the Sach foot is solid, produces only simulated motion, and is lightweight, durable, relatively inexpensive, and provides nice smooth foot action when walking. Another option is the single-axis foot. This articulated foot allows ankle motion which assists in making the knee stable.

Recently a great deal of research has produced feet with flexible heels, which allow amputees to “spring” on and off the foot as they walk. These feet bend when walking and because of their design, the materials store and release energy like a spring. These feet are sometimes referred to as “energy storing” or dynamic response feet. Some of these energy-storing feet have been shown to actually save energy for the amputee as he/she walks.

Your prosthetist will detail the many foot operations and will further explain any special considerations in dealing with your individual situation.
WHAT TO EXPECT ON YOUR VISITS TO BALLERT

At your **first appointment** following surgery, you will complete a patient information sheet, a certified prosthetist will examine you and evaluate your condition, and, depending on the outcome, you will be casted for your prosthesis. Your prosthetist may assess the strength and range of motion of both hips as well as evaluate your sound side limb (non-amputated limb). You will be given this patient instruction brochure and a second visit will be scheduled for approximately one week later. The entire visit should last less than one hour.

Your physician and prosthetist will decide which type of prosthesis will be best for you. The prosthetist will then design, fabricate and fit a prosthesis custom made to meet your particular needs. He/she will work closely with the other members of your treatment team, your physician and physical therapist (PT), to ensure that you receive the maximum benefits from your prosthetic care. You will continue to see your prosthetist over your lifetime for adjustments, repairs and replacement of your prosthesis.

At the **second appointment**, your certified prosthetist will check the fit and alignment of the socket. Often with the help of a temporary pylon and foot, the prosthetist will evaluate the socket’s ability to bear weight and the patient’s ability to stand and to walk in the device. The prosthetist will answer any questions that the patient may have. Patients are usually asked to bring a pair of shoes to this visit, which can last from 30 minutes to one hour. At the end of this visit, a third appointment will be scheduled for approximately one week later.

At the **third appointment**, your certified prosthetist will fit the definitive socket for alignment of height and gait. Depending upon the outcome of this fit, the patient may be given the device to wear for up to two weeks even though it lacks a cosmetic cover. (It is mechanically finished and safe.) At this appointment, the prosthetist will instruct the patient in how to don and doff the prosthesis, together with instructions on how to clean and take care of the device. Additionally, a schedule for wearing the device will be tailored to the abilities of each individual patient. This appointment can last from 30 minutes to one hour.

Appointments are made at weekly or biweekly intervals until all the adjustments have been made and the device fits the patient comfortably.

**Follow-up appointments.** Regular follow-up appointments may be scheduled to check the fit and alignment of the device. At a minimum, you should visit your prosthetist for an evaluation every six months to one year.

If for some reason you cannot make your appointment or are running late, please call us at (773) 878-2445.

**Donning the Suction Socket**

A number of methods of donning the suction socket have been devised over the years. Each amputee needs to experiment to determine the method that seems easiest for him or her.

The three most popular methods are:

1. Use of a nylon stocking or a single layer of tubular stockinette over the residual limb and removing it through the valve hole as the residual limb is “pumped” into the socket.
2. Use of tubular stockinette that has been doubled over the residual limb and removing the stockinette by pulling the end of the outer layer through the valve hole as the residual limb is “pumped” into the socket.
3. Use of an elastic bandage that has been wrapped tightly around the upper half of the residual limb and then pulled through the valve hole as the residual limb is “pumped” into the socket.
Maintenance of the Prosthesis

When a non-articulating foot is used, there is very little maintenance required for the above-knee prosthesis other than keeping it clean inside and out. Articulated feet generally need to be lubricated at regular intervals.

The heel height of the shoe is an important factor in the alignment of the prosthesis. Therefore, when shoes are changed, it is important that the effective heel height be the same as the ones used previously. The effective heel height is obtained by subtracting the thickness of the sole of the shoe from the apparent heel height. For the same reason, heels of the shoes should be replaced frequently so that wear will not result in alignment changes. Also, a badly worn shoe will increase the wear on a prosthetic foot.

Your prosthesis should not be worn without shoes. Not only will it cause excessive stress on the stump and knee joint, but the wear on the foot will result in permanent misalignment. Most prostheses are water-resistant but few are waterproof. If the foot becomes wet, the shoe should be removed as soon as possible to facilitate drying.

If the amputee has any doubt about the fit, alignment, or condition of the prosthesis or residual limb, he should consult his prosthetist immediately. Maintenance requirements for knee units vary. Prosthetists will give instructions for maintenance except for hydraulic units which must be taken care of by the prosthetist or manufacturer. An exchange unit can be provided when a hydraulic unit has to be removed for repair.

Care of the Residual Limb

Daily Cleaning
1. Remove the liner by unrolling it off your residual limb so that the gel side is facing out.
2. Clean the gel side of the liner thoroughly with hot tap water and a soap that does not irritate the skin. For best results use a soap that is free of colors and perfumes (e.g., Palmolive Clear). Apply the soap by hand or with a clean, soft cloth.
3. Rinse thoroughly to ensure that all of the soap residue is off the liner.
4. Dry the gel side of the liner with a lint-free cloth or paper towel.
5. Continue by washing your residual limb.
6. Cleansing may be required more than once a day during the hot summer months, or if heavy perspiration occurs.

Weekly Disinfection
1. Place a small amount of isopropyl alcohol (no more than 2 Tbs.) on a clean, soft cloth.
2. Lightly wipe the gel side of the liner (the surface that is against your skin) for 2 minutes.
3. Rinse off excess alcohol, and ensure that the liner is dry before reapplying. Alcohol that may remain on liner surface can cause minor skin burns if trapped against the skin inside the liner.
4. Do not use excessive amounts of alcohol. Extended contact will stiffen the liner.

Daily Inspection
You should inspect your liners on a daily basis. Unusual wear of the fabric or gel may indicate changes in the prosthetic fit. Rotate your liners daily; wear one while the other is being cleaned and dried. Contact your prosthetist at the first signs of wear or a tear. When the liners are not in use they should be placed on the drying stands and stored in a cool, dry place. Proper cleaning and rotation of liners will allow fresh mineral oil to flow to the surface and extend the life of your liners.

ABOUT BALLERT

Ballert, an ABC certified facility, is one of the oldest and most prestigious prosthetic firms in Chicago. ABC certification means that Ballert meets all of the professional and quality standards set by the American Board for Certification in Orthotics and Prosthetics, Inc. These standards provide you with the finest orthotic and prosthetic devices. Whether your doctor prescribes an off-the-shelf or custom designed and manufactured device, you are assured that Ballert will stand behind its products and will work with you and your doctor to assure the proper balance between