

THE PROCESS OF CREATING A PROSTHESIS

by Bill Copeland, CP, LP

During the 20 years of my career, I have seen great strides in the science and fine art of prosthetic rehabilitation. As an amputee and a prosthetist, I have always had a burning desire to improve the world of prosthetics with better comfort, function, and cosmetics.

The procedures I use to fit an amputee with a new prosthesis have been learned through experience, and with the help of my customers and mentors. Together with their input and feedback, and through attending seminars, workshops and local support groups, I have seen a great evolution in the design and comfort of prostheses.

Like me, many amputees offered their bodies as guinea pigs, testing new socket designs, high-tech materials, and sophisticated knees and elbows. Often, when attempting to implement our new ideas, we ended up with broken devices, which served to promote further research and development. The Paralympic athletes, who recently competed in Sydney, are the modern-day test pilots in the pursuit and discovery of a better design.

Advances in technology, including lighter weight, stronger materials and more anatomically correct, contoured, flexible sockets, benefit all amputees. Componentry, more "intelligent" than ever before, marries microchip technology with robotics to further enhance prosthetic capabilities.

Focusing the advances of technology into functionality for the patient, the prosthetist creates a device, which is comfortable and enhances the personal ambitions of the amputee. The best results come from an experienced and talented clinician who is always thinking and planning.

Educating and explaining to the amputee what to expect is an important role that we assume as healthcare professionals. The responsibility for keeping abreast of new developments rests with both the patient and the prosthetist, thus assuring a positive overall outcome for the amputee.

These are exciting times for clinicians and amputees alike. With current advances in prosthetic technology, and resources available worldwide, the amputee should be able to be both functional and comfortable.



Consultation/Evaluation

Pre-Amputation Consult

Ideally, if you are facing amputation due to disease or elected surgery, you will feel much better if you can speak to a prosthetist who can provide important information about what your realistic expectations should be. Speaking to an amputee close to your age, gender and amputation level can be another source of quality information. You may be able to find a "peer visitor" through a local support group. If you need help locating a support group in your area, call the ACA National Limb Loss Information Center toll-free at 1-888/267-5669.



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Evaluation for Definitive Prosthesis



This is the beginning process of designing and fabricating your new prosthesis. At this time, your prosthetist will be asking questions about your previous activities, work, and recreation. The information is used to ensure that the resulting prosthesis complements your lifestyle and best suits your functionality. Speak up about issues or concerns you've had in the past. Each new prosthesis should be better than the last. Remember, you are the one who has to wear this device day in and day out, so you want to be vocal about its comfort and function.

Different issues will be discussed and agreed upon, including socket design, materials, componentry, and how long the whole process should take. A wide selection of materials and componentry to make your prosthesis is available; therefore, questions about the materials to be used are appropriate at this time. Your prosthetist will use the materials best suited depending on the information you give him. The choice of materials will not only affect the performance of your prosthesis but also the cosmetic appeal. With the right information, your prosthetist will be able to design the most functional and comfortable prosthesis for you. Like a snowflake, each person is unique. What may be right for one amputee may not be right for you. Your communication plays an important role in making your prosthesis work for you.

Cast and Measurement

This stage is where the design of the socket begins, with a mold of the residual limb, or "stump," being made either by hand or digitally scanned by a computer. Due to volumetric and physical changes of your residual limb, taking good measurements and keeping those measurements in your file or on a computer disk for later reference can help to justify future fittings and adjustments.

Once the cast is taken, it is filled with plaster, and then modified to enhance comfort and weight-bearing areas.

Diagnostic Test Socket

Most practitioners will use a diagnostic test socket for the "definitive prosthesis" to ensure a satisfactory comfort level. Normally this is fabricated from clear plastic, which enables the clinician to see the residual limb and visually identify possible pressure problems and adjust the test socket before creating a permanent socket. This is a critical part of the process and for the hard-to-fit amputee, there may be a need for more than one test socket to ensure a proper fit.

Dynamic Fitting and Alignment

At this stage of the process, the prosthesis will be tested for comfort and function. The prosthetist will make the necessary adjustments in the office before letting you try it on for a one- or two-week test run. Don't rush this stage! You want your prosthesis to be as comfortable and functional as possible. It is easier to adjust the prosthesis before a cosmetic cover is applied.



Cosmetic Restoration

The final stage can be very exciting for amputees, especially for those who are more cosmetically conscious. Most amputees want their prosthesis to look and work as naturally as possible. If we look good, we will feel better about our inconvenience and ourselves. Some choose to have artificial skin applied that can give the prosthesis a very natural appearance. Prefabricated skin coverings offer a wide array of skin tones, and some facilities have their own artists who can add a further touch of cosmetic realism by adding veins, freckles, hair and blemishes to the prosthetic cover.

Twenty years of experience has also been 20 years of learning for me. The knowledge I have gained is always enhanced by interactions with my customers. Technology will continue to march forward and there will be new and better materials. The next amputee who needs a prosthetic device will be unique in his or her needs. Care and proper attention by a certified prosthetist will assure him or her of a smooth process and a functional prosthesis.



About the Prosthetist:

Bill Copeland, CP, LP, is a lower-extremity specialist who trained for 15 years as assistant chief prosthetist of the Sabolich Prosthetic Research Facility in Oklahoma. He opened and served as clinical director for the Sabolich Florida division and later served as lower-extremity specialist of Florida for NovaCare/Sabolich. Currently, Bill Copeland heads up his own team at Copeland Prosthetics and Orthotics in Tampa, Florida. He can be reached for comments toll-free at 1-866/330-5300 or on his Web site:

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Process of a Prosthesis

1. Pre-Amputation Consult

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2. Control Swelling

About two weeks after surgery or when the limb is well-healed and there is no drainage, a shrinker is applied to the residual limb. This is to reduce swelling and help develop a conical shape in preparation for the initial prosthesis.

Fitting Someone for a Prosthesis

3. Temporary Prosthesis

About four weeks after surgery a temporary prosthesis is fabricated. We sometimes call this a temporary or preparatory prosthesis because the residual limb will continue to reduce in volume and change shape dramatically over the next several months. During the first 2-6 months you will be monitored closely, and many adjustments and alignment changes will be made as you improve with the help of physical or occupational therapy. The temporary prosthesis will be used until the amputee has reached a stable volume.

Plaster Bandage Wrap

A plaster cast of the residual limb is made.



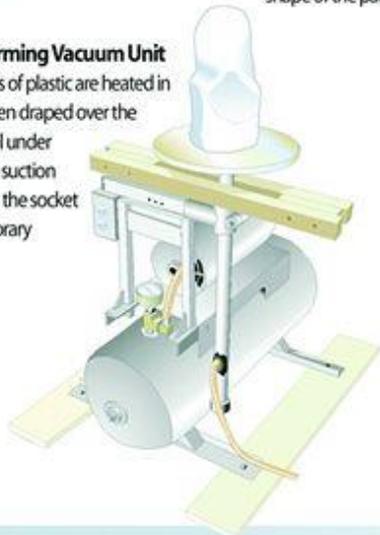
Plaster Model

The model made from a plaster cast serves as a mold for fabricating a temporary socket from such materials as plastic or acrylic. At this point specific modifications are made to accommodate the anatomical shape of the patient's residual limb.



Thermo-forming Vacuum Unit

Square sheets of plastic are heated in ovens and then draped over the plaster model under vacuum. The suction helps to form the socket for the temporary prosthesis.



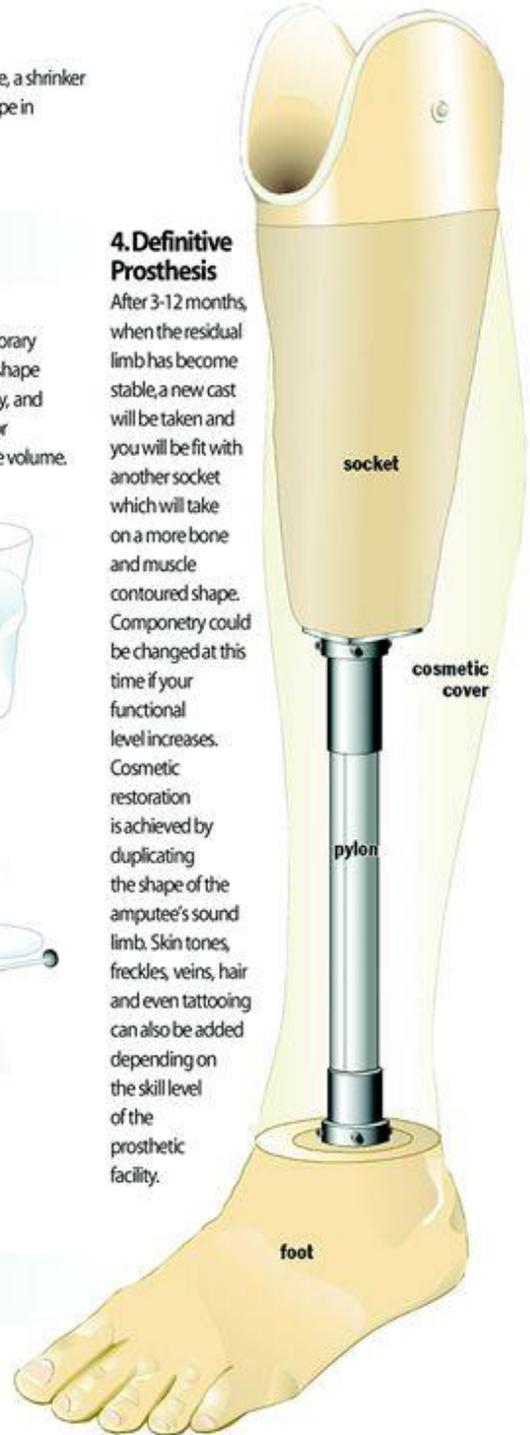
Final Stage

The plaster model is removed from the plastic shell and the shell is trimmed and ready to attach to a pylon and foot.



4. Definitive Prosthesis

After 3-12 months, when the residual limb has become stable, a new cast will be taken and you will be fit with another socket which will take on a more bone and muscle contoured shape. Componentry could be changed at this time if your functional level increases. Cosmetic restoration is achieved by duplicating the shape of the amputee's sound limb. Skin tones, freckles, veins, hair and even tattooing can also be added depending on the skill level of the prosthetic facility.



Basic Types of Feet



Solid Ankle Cushion Heel-SACH Foot



Articulated Ankle/Foot



Dynamic Response Foot (energy storing)