Creating a 21st Century Prosthetic Socket

Transfemoral amputee John T., 45, presented with a seven-year-old, outdated prosthetic leg, which no longer fit or functioned properly.

Like many traumatic amputees, John maintains an active lifestyle and expects a lot from his replacement limb, including comfort, performance and endurance. For those expectations, an intimate socket fit is essential. John’s prosthetist recommended an all-new limb design and components featuring a rigid laminated socket with suction suspension, polycentric knee unit and dynamic foot.

The process began with a CAD scan and digitizing of John’s residual limb contours, from which his prosthetist performed the initial mold and smoothed. Voilà: Finished socket!

Once the soundness and fit of the socket were confirmed, John’s new leg was completed with attachment of the remaining prescribed components: knee, pylon, foot and ultimately a cosmetic cover.

Outcome: John is now able to work, play and “go” harder, longer and with more enjoyment of life. He readily credits his new socket fit and the effort and technology that went into it.

Note to Our Readers

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Charles Coulter • Fillauer Inc. • Ohio Willow Wood Otto Bock Health Care

Fabrication

Adding catalyst-pigment mixture to activate socket lamination.

Delivering on the Promise Of O&P Design Excellence

E ven wonder what goes on in the “back office” of an orthotic-prosthetic practice? Most health care professionals involved in the care of physically challenged patients and those who wear prosthetic and/or orthotic devices have never ventured into an O&P fabrication lab or witnessed the decision-making and craftsmanship that goes into the creation of current-generation prosthetic limbs and orthopedic braces. Were they to do so, they would gain a good appreciation of the three essential ingredients of orthotic-prosthetic fabrication:

• Technology — The science and know-how we employ to build the optimum level of function, comfort and durability into every device;

• Materials — The advanced plastics, metals, fabrics, and other raw components we use to create advanced, functional limbs and braces for every patient; and

• People — The trained and highly skilled personnel whose talent, compassion and experience fulfill the promise of great orthotic and prosthetic designs and thereby help patients realize their lifestyle and vocational goals.

To produce a superior outcome for amputees and individuals requiring orthopedic braces, O&P assistive devices must: (1) fulfill the functional potential of their design, (2) fit intimately and wear comfortably on the patient’s anatomy, and (3) be sufficiently durable to withstand the stresses of daily use.

Present-day prosthetists/orthotists are well-trained to determine what goes into the creation of current-generation prosthetic limbs and orthotic-prosthetic fabrication:

• People
• Materials
• Technology

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Doctor, Are You Registered?

The PECOS system was officially enacted in July 2010 and is now operational. The deadline for rejection of prescriptions from physicians not registered with PECOS is Jan. 1, 2011.

Please remember: After that deadline, neither we nor any other facility can accept prescriptions from non-registered physicians for Medicare patients to receive prosthetic or orthotic care, supplies or durable medical equipment.

Information on PECOS and how to enroll is available at: www.cms.hhs.gov/MedicareProviderSupEnroll
How Great Prosthetic Limbs and Orthoses Come to Life

(Continued from page 1)

Building Blocks of O&P Fabrication

Strength, light weight, durability and comfort are paramount requisites for modern prosthetic and orthotic devices. From space-age plastics and high-tech composites to advanced metal alloys, today’s O&P fabricators enjoy tremendous flexibility to choose materials that will produce the best combination of these variables for each patient’s individual needs.

High-temperature sheet plastics provide varying degrees of rigidity, thickness and color for use in prosthetic sockets and a wide range of orthotic devices. Polyethylene, for example, is a highly flexible soft material that can be formed to cool to retain the desired shape. Heating thermoplast prior to shaping over positive mold.

Molds and Measurements

In standard casting, a plaster of Paris impression is wrapped around the affected limb or torso to create a three-dimensional mold. Upon hardening, the mold is carefully removed, sealed and filled with plaster to create a positive model of the body segment on which the prosthetic socket or orthosis will be formed.

A contemporary alternative, computer-aided design (CAD), allows practitioners to design and modify O&P components with mouse and monitor. Once completed, the design can be exported to a computer-aided manufacturing (CAM) cutter to generate a foam positive model. The resulting model is then used to guide the orthotic casting process.

Technology

.Layered plastic sheeting

When cast in liquid, the plastic quickly hardens to create a positive form that is lightweight, strong and flexible. Resin is introduced to fill the mold, creating a strong positive model that can be used for reference and the subsequent orthosis fabrication process.

Materials

Selection of foams used in fabricating and adjoining O&P devices.

Reinforcing fabrics for O&P laminations

The introduction of sheet thermoplastics and thermoset plastic laminations has revolutionized the fabrication of limbs and braces, providing a total-contact fit and superior strength in a lightweight package.

In both upper- and lower-extremity prosthetic limbs, custom socket forms key the interface between anatomical remnant and replacement limb. Getting the socket right is critical to functional success; thus, one or more check, or test, sockets of transparent plastic may be fabricated to ensure an optimal fit. When the definitive (final) socket is ready, the limb is completed with various pre-made components (feet, knees, pylons, hand units, etc.) chosen specifically for that patient.

Plastics are used to an even greater extent in orthosis construction, notably in ankle-foot orthoses (AFOs), spinal braces, upper-extremity orthoses and cranial remodeling helmets. Various foams and fabrics are added for enhanced comfort and skin protection.

Fabrication time can vary considerably depending on design complexity and patient characteristics. Some devices can be made in hours; others take many days. Our intention is to take whatever time is necessary—but no more—to fabricate every limb/brace as “right” as we possibly can.

We welcome your questions and comments regarding the fabrication process.

The Folks in the Back

The descendants of today’s O&P practitioners can be traced back many hundreds of years to the town blacksmith, armorer, or “brace-maker.” Though “uneducated” in the classroom sense, those craftsmen used their knowledge and ability to process and shape the raw materials of the time to provide their neighbors with assistive devices (splints, braces and artificial limbs) with which to carry on after bone-setting or amputation surgery.

The role and scope of orthotic and prosthetic practice have advanced significantly since those days, now requiring formal education (generally at least a bachelor’s degree), board certification and licensure in many states.

As the effectiveness and complexity of the specialty have grown, today’s orthotists and prosthetists now spend increasingly more time in the clinician role—interacting with patients, evaluating their condition, needs and desires, then designing and fabricating the most appropriate rehabilitation device for those variables.

While many prefer to translate their designs into a finished brace or limb by constructing it personally, others find they are more productive in collaborating with and supervising the “brace-makers” of today—prosthetic and orthotic technicians—in the fabrication of the finished appliance.

O&P tech function under the direction of board-certified orthotists and prosthetists in bringing both routine and technically advanced limb and brace designs to reality.

Some have amassed ample experience in their specialty and define career fulfillment as maximizing their contribution at the technical level. Others are motivated to further develop their education and talent on the path to becoming board-certified prosthetist-orthotists. In either case the abilities of these valued personnel can now be recognized by their own credential granted by the American Board for Certification in Orthotics and Prosthetics—Certified Orthotist and/or Prosthetic Technician.

Whatever their career goals, rest assured O&P technicians are some of the most creative and talented individuals in our business.

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Polyethylene is widely used in the fabrication of orthotic and prosthetic devices due to its extremely high strength and low weight. In addition to sockets, carbon composites are used extensively in AFOs and KFOs (including sidebars), prosthetic pylon, knee, joint, and dynamic response feet.

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Designing the socket.

Forming the check socket.

Adding catalyst-pigment mixture to activate socket lamination.

Fabrication

Current Developments in Prosthetics & Orthotics No. 63

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Present-day prosthetists/orthotists are well-trained to determine their patients’ capabilities, needs and functional desires and to design a prosthetic limb or brace to maximize mobility and lifestyle within those parameters. It remains for the device built to that design to deliver on the promise of the clinician’s vision, a result that inevitably depends on careful, accurate fabrication.

Because of the critical role of the prosthetic socket as the connecting link between human anatomy and prosthesis, most all prosthetic limbs today are custom-fabricated. Although some bracing needs can be solved with prefabricated products, the majority of orthosis designs depend on a precise, total-contact fit and thus require custom manufacture.

An off-the-shelf device is modified and adjusted to achieve the best result possible, given that its fit is, at best, an approximation. Custom prostheses and orthoses, on the other hand, are one-of-a-kind devices molded intimately to a cast or computer-generated model of the patient’s anatomy to deliver the best result possible.

(Continued on page 2)