Orthotics and Prosthetics Go Digital

Digital, 3D systems are enabling orthotic and prosthetic devices that provide a better fit and a shorter manufacturing time over more traditional solutions. This article reviews the additional benefits realized from using these innovative options and also examines the technology involved in the systems. Further, a real world "case in point" is shared to illustrate the advantages.

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The digital revolution—or more aptly, evolution—is underway in the field of orthotics and prosthetics (O&P) as formerly manual processes in the workflow are being replaced by digital technologies little by little. "Second generation" CAD/CAM tools are resulting in more accurate, better fitting, and more reproducible orthotics (spinal braces, ankle-foot orthotics, and pedorthics) and prosthetics (artificial legs and arms). This digital workflow is currently creating opportunities for savvy medical application developers and integrators, as well as O&P practitioners, and can also lead to better patient outcomes.

Better Fit, Greater Patient Ease

O&P practices are embracing the new "no plaster" workflow that begins with a 3D scan of the patient's body, which is then used to create an accurate digital model that can be modified in software to best treat the patient's condition. This process enables the following.

Faster, More Accurate Fittings

Traditional O&P practitioners have long worked by first creating a physical cast from plaster of Paris by wrapping the already uncomfortable patient with wet, sticky material that required them to sit or lie still until it hardens. Or, less precise models were made from a series of measurements taken with a tape measure. Today's approach of starting with a 3D scan of the patient's body produces a precise, accurate "digital cast" in a fraction of the time, and with greater patient comfort.

Custom, Precision Fit

A custom fit is far better than off-the-shelf options. Through precise, digital non-contact scanners, the 3D shape of the body surface can be obtained without the time or patient discomfort of making a plaster cast. Such digital casts provide an accurate 3D view of the body in a more complete way than just relying on a few measurements taken with a measuring tape—providing a patient-specific fit.

Easy Repeatability and Access to Data

When replacements or incremental revisions are needed, the 3D model enables the device to be easily replicated. The scan can also serve as an electronic medical record to meet regulations or for clinical communication or reimbursement.
More Intuitive Computer Use

Today's second-generation systems are much improved in terms of graphics, templating, and integration with data from 3D scanners. The underlying approach, however, can still require the prosthetist to view and modify the shape they are working on in a very unnatural and indirect way—as horizontal slices through a cylinder. Third-generation "Sculptural" CAD solutions allow O&P practitioners to work intuitively using their sense of touch to scrape and smooth "digital plaster" (Figure 1) as if they were using their hands to create and modify a physical cast. These solutions make the design process simpler, faster, and more efficient.

Outsourced Positive Fabrication

In-house milling means that some O&P companies maintain a storeroom full of foam torsos, shoulders, or hips in various sizes, in addition to a separate cleanroom for the mill. By working digitally, practices can outsource the entire process to a number of available fabrication facilities. Some practices have reported saving at least one-third or more of the total time to design, modify, and fabricate a finished orthotic or prosthetic using a Sculptural CAD system.

Automation

With tight reimbursement levels and rising case loads, the O&P industry is looking to streamline workflow and production processes.

Case in Point: Spinal Braces for Scoliosis

Technic'Ortho of Lay-Sainte-Christophe, France specializes in the design and manufacture of sophisticated orthotics and prosthesis for the back and lower limbs. For years, the firm made patient impressions in the traditional plaster method. Recently, Technic'Ortho implemented the Byosys Mizar solution from Kallisto, a provider of rapid prototyping and 3D technologies based in Toulouse, France. The Byosys Mizar solution includes:

• A hand-held, external 3D scanner developed for O&P applications that can be carried into hospitals, clinics, or the patient's home (Figure 2)

• An industry-standard PC

• Specialized Byosys Sculptural CAD software developed by SensAble Technologies for O&P design

• A Phantom haptic (force feedback) device from SensAble Technologies that the user designs with instead of a computer mouse

• A specialized carver designed by Kallisto for milling the orthotics in foam

The solution allowed Technic'Ortho owner Benoît Baumgarten and his colleagues to design custom spinal braces (Figures 3) rapidly, more comfortably for the patient, and with better precision than sculpting from foam. The team completed the scan, design and manufacturing of a final foam model for the spinal brace in about one hour, instead of the six hours (spread over several days) needed when starting from plaster casts that must dry before being carved into shape. What's more, the digital workflow enabled Technic'Ortho to deliver a completed brace to the patient in four weeks, instead of six weeks, allowing both better patient care and a more efficient work process.
The 3D scanner allows the orthotist to capture a highly precise, high resolution scan quickly without touching the patient. The user can then crop the patient's torso area and access pre-stored libraries of data for specific types of spinal braces to efficiently modify them based on the unique anatomical shape of each patient. The digital model is then sent to a carving machine, similar to a giant lathe, where the torso is milled in foam. The foam model is used as a mold to thermof orm the brace using traditional methods, which is then smoothed, hinged, and vented. Buckles are also applied before delivery to the patient.

Because the user holds a Phantom haptic device instead of a computer mouse, they sculpt the "digital plaster" they see on screen—a more natural and intuitive way to use a CAD system. The system allows the orthopedic specialist to take advantage of their years of expertise in traditional methods, and directly transfer it into the digital realm.

"With the haptic device we obtain the same feeling of scraping the plaster form into shape, but without having the disadvantages of losing time going back and forth from the digital file to the physical model," states Baumgarten. "The system also lets us more easily correct instances when the model is slightly off in any dimension. We don't have to remake the entire physical model when it needs to be adjusted."

Having a digital file also provided Technic'Ortho with an electronic record as required by the French government's "sécurité sociale," or Medicaid equivalent, instead of having to keep the plaster model.

Technic'Ortho also uses Byosys Mizar for a variety of other orthopedic-related equipment, such as made-to-measure mattresses that assist scoliosis patients to sleep in the correct posture (Figure 4).

Conclusion

CAD technology is giving O&P practitioners more quality time to work with their patients and enabling them to transform their practices into cleaner, more efficient businesses. Using digital solutions, they are delivering custom orthotics and prosthetics with improved fit, faster, and with a better experience for the patient. Given today's market, such efficiency is not only smart, it's essential.

Online

For additional information on the technologies and products discussed in this article, see MDT online at www.mdtmag.com and the following websites:

• www.sensable.com
• www.byosys.com