Surgeons use 3-D prototyping and Selective Laser Sintering to plan and guide surgical procedures

First came the obvious; using rapid prototyping (RP) technologies such as 3D Systems’ SLS process, to streamline the development of production of industrial and commercial parts and products.

Then the scientific community got into the act. They began using RP technologies to replicate fossils and archaeological relics. Here, replicas of rare finds are created and distributed to interested parties. This allows simultaneous studies to take place by more than one scientific community or institution. In addition, distributing the replicas ensures that the precious original is kept in one safe location - or repatriated if necessary.

Manufacturers. Scientists. Now it seems the medical and dental communities are getting into the act.

**Scanning and planning**

In a report out of Technikon Free State, a technical university in Central South Africa, D.J. DeBeer and R. Schenker outline various cases where 3-D imaging and RP technologies including the SLS process, have been used in medical and dental applications.

One such case involves a 41-year old patient who required a dental implant. Here, the attending prostandontist agreed that capturing the geometry of the patient jaw region could help determine if the patient had sufficient bone structure for a successful operation. Another case involved a male patient who needed a hip transplant. Scanning and reproducing the patient's data helped the orthopedic surgeon determine whether or not the patient was a good candidate for the procedure.

The surgeon then used a 3-D prototype (made via RP) to plan the surgery and ensure that the prosthesis would indeed fit the patients’ pelvis.

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The surgeons worked with ease with the functional prototype. The skull prototype was marked and cut in sections as the surgeons planned the operation. A brace was then fitted to reposition the eye socket section. The surgical team referred frequently to the prototype during the eight hour operation.

Further, Mr. DeBeer notes that, “Distance played no role in this first-of-its-kind case study in South Africa, as participants from the Technikon Free State, the Council for Scientific and Industrial Research (CSIR), as well as the University of Pretoria of 450 km apart.

**Part of the surgical landscape**

Dr. Scott Rake, D.M.D., an oral and maxillofacial surgeon and Associate Professor at the University of Minnesota, USA, agrees that using 3-D prototyping technologies to create models of patients skulls and facial regions is advantageous for both the doctors and the patients. As a result, he says he sees use of these prototypes becoming more and more prevalent.

Dr. Rake and his colleagues have used 3-D models to plan surgeries for a number of patients, including those with severe facial trauma, congenital craniofacial defects, and other syndromes. They also have used them to plan resections of large tumors in the facial region and to help create custom temporal mandibular joint (TMJ) prostheses.

Dr. Rake cites several recent cases, similar to those mentioned earlier: a 40-year old male who received several facial fractures in a motor vehicle accident; a 55-year old female who required a TMJ prosthesis and a 45-year old male with a tumor in his lower jaw. In these instances, 3-D models were created and used to help surgeons plan and enhance these surgical procedures.

Speaking from first hand experience Dr. Rake emphasizes the advantages of using 3-D models in planning medical and dental surgical procedures. “First we can better visualize the defect and therefore plan the surgery more easily. Second if fixing devices such as titanium plates and screws are needed we can select and adapt them prior to the operation. Finally it makes fitting TMJ prosthesis easier because we can use one that is custom made rather than ‘off-the-shelf’. In all these cases, it’s a new and exciting way to help ensure a better outcome for the patient.

**An Optimistic Prognosis**

Dr. Rake is optimistic on the future of these techniques. “It’s true that using 3-D prototypes is rather expensive now,” he says, “but costs are coming down and insurance companies are more willing to pay for these procedures because they help reduce our operating room time, they help ensure a better outcome for the patient, and they can help us avoid additional surgeries. I see this becoming more and more prevalent in coming years as our profession and the patients experience the advantages.”