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MONEY- AND PAIN-SAVING ARTIFICIAL BONE IMPLANT CREATED

Urbana, Ill., June 10, 2003 — In a unique moment of convergence, a long-distance, multi-disciplinary collaboration has resulted in an elegant solution to a painful and costly problem — how to avoid having to harvest bone from a patient to repair another site in the body.

A maxillofacial surgeon from Carle Foundation Hospital in Urbana, Ill., a materials scientist from the University of Illinois, computer modelers from the university's Beckman Institute and fabricators from Sandia Lab in Albuquerque have joined together to create a precise replacement for part of a human jawbone.

Currently, to replace severe bone loss in the jaw, surgeons harvest a piece of bone from a patient's pelvis, then sculpt that piece into the precise shape needed and insert it into the patient's jaw. Even for highly skilled surgeons, this sculpting step takes an hour or more in the operating room, with the patient anesthetized the whole time. The hip surgery can be far more painful and includes more potential complications than the jaw surgery that prompted it. The artificial bone implant is less painful and risky to the patient and provides enormous savings to the healthcare system, both in operating room costs and hospital recovery time.

Michael Goldwasser, D.D.S., M.D., Carle surgeon and University of Illinois professor of surgery, had long wished for a jaw implant that would negate the need for painful hip surgery. The problem is, the particular contours of the mandible are quite complex and it is critical for an exact match with the existing bone. A poor fit can be painful, especially if it impinges on the facial nerves.

"I identified the problem and was looking for a solution," says Goldwasser. "The intellectual brain trust at the university and Sandia Labs made it all happen."

As luck would have it, Russ Jamison, Ph.D., professor of materials science and engineering at the University of Illinois, came to Goldwasser as a patient. Jamison develops artificial scaffolds that act as a placeholder for bone and soft tissue to regrow around and through. Jamison studies the load-bearing strength of these scaffold structures. That ability to bear loads is particularly important in the jaw, which undergoes extreme pressure during normal use. The scaffolds are made from hydroxyapatite, a material that is chemically identical to human bone.

Goldwasser described his dream of an implant, and a collaboration was born.

Jamison also put Goldwasser in touch with 3D modeling experts Benjamin Grosser and Janet Sinn-Hanlon at the University of Illinois Beckman Institute's Imaging Technology Group (ITG). The modelers started with 2D CT scan data of the patient's jaw (collected by Sue Hartman at Carle). Using the computer and Goldwasser's intuitive ability to visualize the correct shape in 3D, Goldwasser, Sinn-Hanlon and Grosser worked together to precisely match the congruent side of the implant to the shape of the patient's remaining jaw, while creating a canal to accommodate an exposed nerve.

Once the model was finished, the fourth step involved fabricators at Sandia Lab, led by Joseph Cesarano, Ph.D., who then created the actual implant from the computer data. Sandia used a patented technique, known as Robocasting. Controlled by a computer program, the machine dispenses liquefied ceramic pastes, like toothpaste squeezed from a tube, to form shapes of varying complexity along a prearranged path.

The patient was already scheduled for the harvest and replacement surgery in May, giving the team about two months to create the implant from start to finish. Although this prototype could not be actually implanted since hydroxyapatite is not yet FDA-approved for this purpose, making the deadline would allow the team to demonstrate a "proof-of-concept" — from surgeon's knowledge to a workable implant.

Everything clicked. The prototype was hand-delivered by Cesarano just in time for the surgery. It fit like a glove. The team proved that the design and creation of a jaw implant could be done accurately and quickly. Hydroxyapatite is already an approved substance for use in the body, so FDA approval may come quickly.

For more information and to view photos related to the project, see: http://www.itg.uiuc.edu/technology/reconstruction/ .

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