Virtual surgical planning aids in complex facial reconstructions

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Virtual surgical planning technologies give surgeons a powerful new tool for their most challenging facial reconstruction cases, reports a paper in the September issue of Plastic and Reconstructive Surgery.

"Use of virtual surgical planning allows for complex maxillofacial reconstruction with multiple simultaneous free flaps to be preformed reliably and successfully," according to the study by Dr. Adam Saad of Louisiana State University Health Sciences Center, New Orleans, and colleagues.

Virtual Planning Helps Guide Complex Reconstructions

Dr. Saad and colleagues report their experience with maxillofacial reconstruction in patients with severe facial defects. All patients had severe destruction and distortion of the facial structure, posing difficult surgical challenges with a high risk of complications.

Virtual surgical planning begins with a high-resolution 3D CT scan of the skull and facial defect, and of the donor site from which the surgeon will obtain bone and tissue flaps for use in reconstruction. The CT data are then used to "virtually restore" the patient's preinjury anatomy—including a computer simulation showing how multiple bone-containing flaps would be placed to restore the defect.

The virtual reconstruction is used to create a "stereolithic" model of the patient's skull, including the pieces needed to perform the reconstruction. Surgeons can use the model to create custom jigs for use in performing the necessary bone cuts, as well as pre-bent surgical plates.

Dr. Saad and coauthors used the virtual surgical planning system for reconstruction in 10 patients with severe facial defects, most commonly caused by gunshot wounds or severe radiation damage after cancer treatment. The reconstructions were highly complex and demanding—for example, requiring complete reconstruction of the upper (maxilla) or lower jaw (mandible).

High-Tech Planning May Pay Off by Making Surgery More Efficient

All procedures went smoothly, with no surgical complications. The 3D model helped the surgeon understand the various components needed for the reconstruction, and how they would all fit together. Using custom-made cutting jigs and pre-bent plates allowed surgeons to work more efficiently, potentially reducing operating time.

Follow-up CT scans showed "excellent contour" of the bone flaps used for reconstruction of the facial skeleton. All bone and tissue flaps were viable at three months' follow-up. Where reconstruction of the mandible was performed, functional jaw motion was restored—in some cases, allowing the patient to resume oral feeding.

After initial experience with virtual surgical planning for simpler reconstructions, the researchers evaluated its use for the most complex maxillofacial reconstructions. "Usage of this technology should allow for more precise estimates on required bony components for reconstruction as well as enhancing our ability to make exact osteotomies to better

match the contour of the facial skeleton," they write. They also propose a set of criteria for appropriate use of virtual surgical planning.

Dr. Saad and coauthors believe that the technique will be even more efficient and effective as surgeons gain familiarity with the technology. Although virtual surgical planning carries some additional costs, the researchers think this may be offset by the ability to simplify complex reconstructions. "We do feel that no price tag can be assigned to predictability and streamlining," they add.

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