3-D analysis and CAD/CAM techniques lead to new advances in plastic and reconstructive surgery

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While used mainly in craniofacial reconstruction so far, 3D planning and CAD/CAM techniques have the potential for advances in practically every area of plastic and reconstructive surgery, according to the review by Drs. Miles J. Pfaff and Derek Steinbacher of Yale University. They write, "When properly implemented, virtual surgical planning and CAD/CAM technology enhance efficiency, accuracy, reproducibility, and creativity in aesthetic and craniomaxillofacial plastic surgery."

Engineering Techniques Help Solve Complex Reconstructive Problems

The authors provide an overview of VSP and CAD/CAM technology and its emerging applications in plastic and reconstructive surgery. These powerful techniques—originally developed in the automotive and aerospace industries—are already being used to help surgeons solve complex problems in craniofacial reconstruction through analysis, planning, virtual surgery, 3D printing, and evaluation of surgical results.

Surgeons can manipulate data from computed tomography (CT) scans to create a digital 3D structure, which can then be used for virtual surgical planning. The 3D model allows surgeons to study the patient's specific defect in detail from every angle.

This helps the surgeon in developing and comparing a range of

reconstructive approaches. The procedures can even be "virtually trialed"—the surgeon can perform simulated 3D procedures to "run through multiple treatment strategies to determine the most optimal approach."

The 3D digital information can be used with CAD/CAM technology, 3D printing, and other advanced manufacturing techniques to create biocompatible implants, splints, or treatment guides. After surgery, the planned and actual results can be compared to assess the accuracy and effectiveness of the procedure—which in turn can help to refine and plan future reconstructions.

The article includes case studies illustrating the clinical use of these approaches. These include examples of 3D analysis and VSP for complex reconstructive surgery in patients with extensive facial wounds, and in infants and children with congenital deformities of the skull and facial bones.

"As access to CT and 3D photo imaging improve, VSP and CAD/CAM procedures will become the standard of care," the authors write. While most applications so far have been in the area of skull, face, and jaw reconstruction, Drs. Pfaff and Steinbacher foresee growing use in complete reconstructions of the head and neck, trunk, and limbs. In the future, they envision using VSP to provide lifelike simulations of a wide range of plastic surgery procedures—enhancing outcomes and providing better communication between the surgeon and patient.

Drs. Pfaff and Steinbacher emphasize that these new and emerging techniques can't replace the surgeon's clinical judgment or technical skill, nor can they guarantee perfect results. "However," the authors add, "when properly implemented, VSP and CAD-CAM technology enhances efficiency, accuracy, reproducibility, and creativity in aesthetic and craniomaxillofacial plastic surgery."

More information: Miles J. Pfaff et al. Plastic Surgery Applications Using Three-Dimensional Planning and Computer-Assisted Design and Manufacturing, *Plastic and Reconstructive Surgery* (2016). DOI: 10.1097/01.prs.0000479970.22181.53