Computer aided design

Computer-aided design (CAD) is the use of computer systems (or workstations) to aid in the creation, modification, analysis, or optimization of a design.

CAD output is often in the form of electronic files for print, machining, or other manufacturing operations. The term CADD (for Computer Aided Design and Drafting) is also used.

CAD may be used to design curves and figures in two-dimensional (2D) space; or curves, surfaces, and solids in three-dimensional (3D) space.

For many patients, advanced 3D imaging and use of medical CAD software can improve the accuracy of treatment planning and the precision of surgical execution [1].

These types of software could also be potentially applied to intraoperative guidance, real-time navigation and patient-customized implants [2] [3].

Virtual preoperative simulation using CAD software has been applied to various surgical areas. In particular, many authors have attempted to apply it to oral and maxillofacial surgery [4] [5] [6].

To convert DICOM files to the standard 3D image format, another piece of software such as ScanIP (Synopsys Inc., Mountain View, CA, USA) or Osirix (Pixmeo SARL, Geneva, Switzerland) should be used. However, with recent advancements in medical CAD software, this software has become more intuitive and simpler. In addition to Mimics we used, Dolphin Imaging (Dolphin Imaging and Management Solutions, Chatsworth, CA, USA) and Maxilim (Medicim, Mechelen, Belgium) were known as medical CAD software [7].

As medical computer-aided design (CAD) has improved, virtual 3-dimensional medical images have been gaining more easily without any special practice. These images can be applied to various clinical fields. This article illustrates virtual preoperative simulation for excision of spinal tumors using medical CAD software. The software was used directly by the surgeon. The process of virtual preoperative simulation for spinal tumor surgery was found to be not inordinately complicated. And, virtual simulation was helpful in determining surgical steps as well as understanding the surgical anatomy [8].

The surgical correction of craniostenosis in children is a time-consuming and taxing procedure. To facilitate this procedure, especially in infants with complex craniostenosis, we refined the computer-aided design and manufacturing technique (CAD/CAM) based on computed tomography (CT)-generated DICOM data. We used cutting guides and molding templates, which allowed the surgeon to reshape and fixate the supraorbital bar extracorporeally on a side table and to control the intracorporal fit without removing the template.

METHOD AND PATIENTS: To compare our traditional concept with the possibility of preoperative virtual planning (PVP) technique, the surgical treatment and courses of 16 infants with complex craniostenosis following fronto-orbital advancement (FOA) (age range 8-15 months) were analyzed in two groups (group 1: traditional, control group n = 8, group 2: CAD/CAM planned, n = 8).

While in both groups, the head accurately reshaped postoperatively during the follow-up; the CAD group 2 showed a significantly shorter operating time with a mean of 4 h 25 min compared with group 1 with a mean of 5 h 37 min ($p = 0.038$). Additionally, the CAD group 2 had a significantly lower volume of blood loss (380 ml vs. 575 ml mean, $p = 0.047$), lower blood transfusion volume (285 ml vs. 400 ml mean, $p = 0.108$), lower fresh frozen plasma (FFP) volume (140 ml vs. 275 ml mean, $p = 0.019$), shorter stay in the pediatric intensive care unit (PICU) (3 vs. 5 days mean ($p = 0.002$), and shorter total length of hospital stay (6 days vs. 8 days mean, $p = 0.002$).

CAD/CAM cutting guides and templates offer optimizing operative efficiency, precision, and accuracy in craniostenosis surgery in infants. As shown in this single-center observational study, the use of on-site templates significantly accelerates the reconstruction of the bandeau. The virtual 3D planning technique increases surgical precision without discernible detrimental effects [9].

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