Abstract:

OBJECTIVE: Computer-aided surgery (CAS) has proved to be useful in reconstructive craniomaxillofacial surgery. Preoperative creation of virtual models by segmentation of the computerized tomography (CT) dataset and mirroring of the unaffected side allows for precise planning of complex reconstructive procedures. The aim of this study was to evaluate the accuracy of the preoperative planning and the postoperative result regarding the skeletal reconstruction. STUDY DESIGN: In a first step, the symmetry of unaffected human skulls and faces were evaluated by 20 midface CT data of skulls and 20 surface-scan data of healthy individuals. By mirroring and adjusting the original and mirrored datasets using a 3-dimensional modeling software, an automatic measurement procedure could evaluate the mean and the maximal modulus of the distances between both datasets. In a second step, 18 consecutive cases were selected which had been treated with CAS support. Group 1 consisted of orbital floor and/or medial wall fractures (n = 12), group 2 consisted of zygomatic bone fractures (n = 4), and group 3 included 2 patients who were treated by secondary orbital reconstruction including reosteotomy of the zygomatic bone (n = 2). To verify the surgical result, the preoperative CT dataset including the virtual planning and the postoperative CT dataset were compared by using image fusion.
Additionally, postoperative surface scans and the clinical symptoms of the patients were evaluated.

RESULTS: No differences between the skull and face symmetry were found. Mean values for
distances considering the skull symmetry were 0.83 mm for male and 0.71 mm for female and for
the face symmetry 0.65 mm for male and 0.76 mm for female. Comparing the preoperative planning with
the postoperative outcome, a mean accuracy of 1.49-4.12 mm with maximum modulus of 2.49-6.00
mm was achieved. Orbital true-to-original reconstructions and the secondary reconstructions were
more precise than the reposition of the zygomatic bones. The postoperative acquired surface scans
resulted in mean distances from 0.89 to 1.784 mm. Despite these deviations, all patients
demonstrated satisfying clinical outcome. CONCLUSION: The natural asymmetry in humans
influences the accuracy of preoperative planning procedure, when the mirroring tool is used. The
accuracy transforming the preoperative planning to the surgical reconstruction using CAS depends on
location, surgical approach, and matter of reconstruction.