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Computer assisted periorbital reconstruction Demonstration of a new method

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Authors: Alexander Schramm, Nils-Claudius Gellrich, Ralf Gutwald, Ralf Schön, Ronald Schimming, Rainer Schmelzeisen
Dept. of Oral and Maxillofacial Surgery, Albert-Ludwigs-University Freiburg, Germany

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Introduction

Among the presurgical planning modalities computer assisted surgery (CAS) is regarded as a perspective, but the combination of preoperative planning, virtual correction, intraoperative navigation and postoperative control has not become a routine procedure in the treatment of orbital deformities yet.

Objective

To get sufficient information on the preoperative situation the surgeon himself has to get familiar with the patient´s interior. Modern navigation systems provide the possibility to handle easily the CT- or MRI data set, so that the surgeon can adjust the grey scale and the reconstructions to his demands.

Material and Methods

In our department the STN-navigation system (Stryker-Leibinger) was used in combination with modified software to fulfil the criteria of presurgical planning, navigation and postoperative control in 25 cases. Alternatively CT- or MRI-datasets can be acquired to serve separately or in combination for computer aided planning and surgery on the workstation. Virtual correction can be performed either by drawing new contours, designing virtual implants on the workstation or by using the mirroring tool, which allows for overlying the ideal contour of an unaffected side upon the deformed side. The "virtual patient" on the workstation and the "real patient" can be fused by using our individual registration system: an occlusal splint in the upper jaw with 4 exchangeable markers in different xyz-axes.

Results

The figures below show one routine assessment for a patient with left posttraumatic enophthalmus and a displaced malar bone. The planning, navigation and control procedure is demonstrated. The unaffected right side is mirrored to the deformed side. This procedure takes 15 min. for the surgeon to create the virtual patient with an ideally corrected periorbital region. The correction of malar bone position after reosteotomy and the augmentation with calvarian split-grafts was finished when the virtual contours of preoperative planning on the workstation and intraoperative navigation of real contours matched. Additionally the pointer system (dotted line) is a valuable tool to check on eye- bulb position in the sagittal plain, thus replacing an exophthalmometer (the ideal position was preoperatively marked with the green bar).

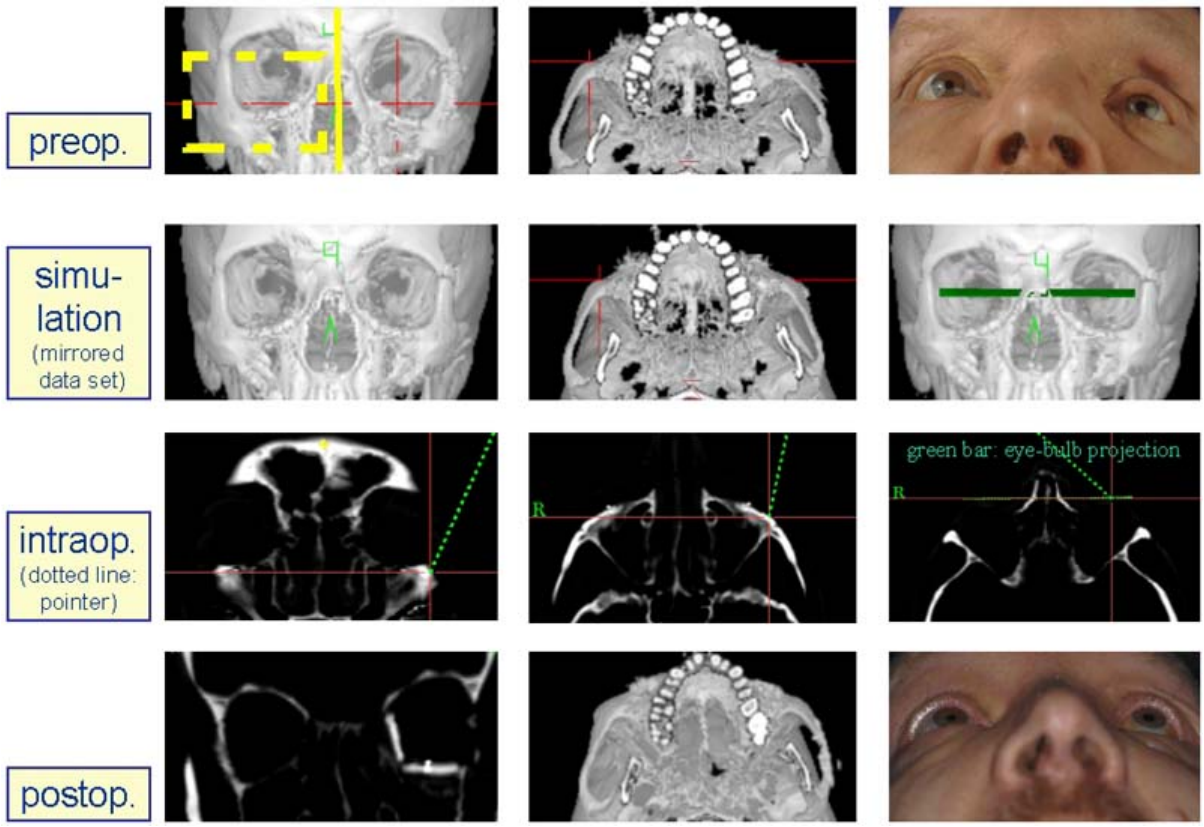

Fig. 1: Computer assisted orbital reconstruction (preop.); ideal virtual reconstruction (simulation) mirroring the unaffected right side; intraoperative control of malar prominence and eye-bulb position (intraop. Navigation) and postoperative result.

Discussion and Conclusions

The following features are important for orbital reconstructive surgery: - Volume measuring allows to quantify orbital contents - Mirroring unaffected parts of the data set to an individually created plain allows for exact restoration of form in definable ranges - Virtual insertion and positioning of autologous bone transplants realizes preoperative simulation of augmenting deficient zones within and around the orbit - Outlining of endangered structures like the optic nerve is easily possible - Intraoperative navigation allows to check on individual anatomy online and to compare preoperatively and virtually planned contours (e.g. eye-bulb or malar bone projection) - In extended craniofacial reconstructive surgery or oncological restaging with postop. CT-/MRI changes between the preceeding and the actual CT/MRI are easily assessable - Stereolithographic models are totally replaced In our experience the promotion of a conventional navigation system in the direction of a "multifunctional planning, navigation and control unit" sets new standards for facial plastic and reconstructive surgery. We are not only using the STN-workstation (Stryker-Leibinger) for orbital reconstructions but as well for complex craniosynostosis and orthognathic cases, midface reconstructions, skullbase tumors, optic nerve decompression and demanding implantology cases.

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Abbreviations

CAS = computer assisted surgery
CT = commuted tomography
MRI = magnetic resonance imaging
STN = surgical tool navigator

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Correspondence address:
Dr. Dr. Alexander Schramm
Universitätsklinik Freiburg
Univ.-Klinik und Poliklinik für MKG-Chirurgie
Hugstetter Str. 55
D - 79106 Freiburg

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