

3D planning and computer-assisted surgery in CMF reconstruction

Introduction

Inadequate reconstruction of the facial skeleton after trauma and ablative surgery is often associated with complications like incomplete correction of enophthalmos, diplopia, hypoglobus and changes in facial geometry. Surgical intervention is often necessary to correct function and aesthetics and to avoid long-term complications.

Especially the severity of an orbital trauma is dependent on the size of a defect, the number of orbital walls involved, the localization of the defect and any technical difficulties during surgical repair. Patient-specific reconstruction is an option to address this.

The benefit of computer-assisted planning and computer-assisted surgery in craniofacial reconstruction has been documented over the last decade. These systems offer a safe and reliable surgical procedure. As a result, the handling of these systems is largely experimental and navigational assisted treatment of facial trauma is not routinely used.

Aim

This masterclass presents a novel solution for computer-assisted planning to design customized implants with predefined useful guidance which optimally adapt to the needs and the anatomical conditions of the patient especially in trauma, ablative surgery, craniofacial reconstruction and orthognathic surgery.

Methods

To demonstrate this novel approach, we show an example of surgical planning and treatment of some patients with a traumatic mandible and midface fracture including the orbit. Based on pre-operative CT data, virtual models of the unaffected bony part were automatically generated using an atlas-based segmentation using 3D planning

software, iPlan 3.0.5, (Brainlab®, Feldkirchen, Germany). 3D mesh was virtually designed using Geomagic-Freeform® Plus (3D Systems, Morrisville, NC, USA). The virtual 3D implant was produced via additive manufacturing (selective laser melting) by KLS-Martin® (Tuttlingen, Germany).

Results

Successful preoperative planning, import of image data suitable for navigation and intraoperative precise infrared-based navigation was obtained for all patients without any complications. The registration of patient data at the navigation system using screws as fiducial markers delivered a navigation accuracy. The novel method of use of PSI showed good postoperative result.

Conclusion

Regarding the advantages of computer-assisted surgery, this technique will play a major part in craniofacial reconstructive surgery and will address widespread general methodological solutions that are of great interest in multidisciplinary treatment.