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The use of zygomatic implants in maxillary reconstruction and the advantages of computer assisted insertion insertion

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Introduction

Installation of fixtures for prosthetic reconstruction in the upper jaw in patients with extensive bone and soft tissue defects is still a challenge. These situations normally require the support of vascularized bone or composit grafts and secondary insertion of endosseous implants. The new fixture developed by Brånemark System achieves instant prosthetic reconstruction by anchoring implants in the zygomatic bone to offer sufficient support even in the above described situations (fig. 1).

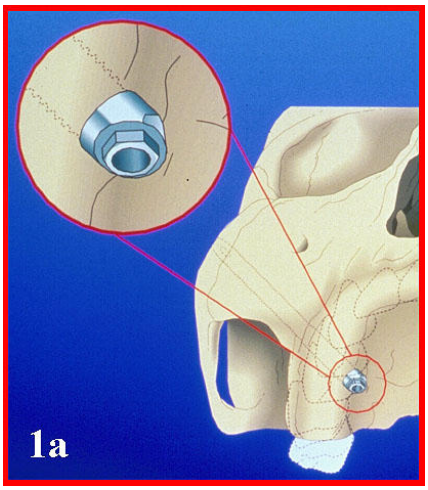

Fig. 1a: schematic drawing of an inserted zygomaticus fixture

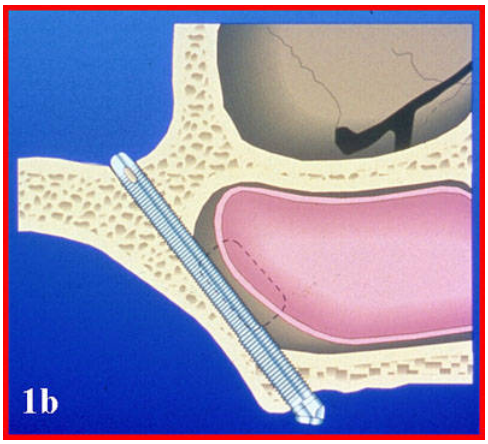

Fig. 1b: coronal view demonstrating the relation between implant and sinus mucosa

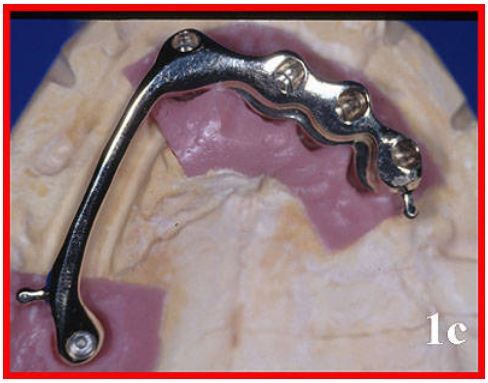

Fig. 1c: maxillary prosthodontic reconstruction in case of severe atrophy (technician's view)

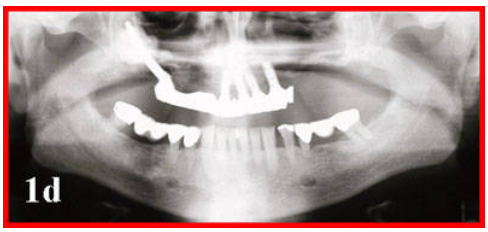

Fig. 1d: postoperative panoramic X-ray

Fig. 1e: clinical view

Objective

The dimensions of these zygomaticus fixtures and the complex anatomy due to previous surgical procedures demand specific treatment for a precise and safe insertion of the implants.

Methods

On the base of an axial spiral CT data set the STN-4 navigation system (Leibinger/Zeiss) was used for preoperative planning and intraoperative controlling of insertion of zygomaticus fixtures after subtotal maxillectomy (fig. 2). Non invasive registration for multiple use in the same patient was achieved fixing referencing markers for CT or MRI scans to an individually performed occlusal splint (fig. 2c) with high accuracy (appr. 1 mm). The head of the patient is normally fixed to a Mayfield clamp which is tracked by a dynamic reference frame to allow changing of the position during operation (fig. 2a). Non invasive tracking can be achieved fixing this dynamic reference frame to the occlusal splint. With this technique also navigational surgery of the mobile mandible can be performed and computer assisted procedures are possible under local anesthesia. With frameless stereotaxy the surgeon is able to localize any desired anatomical structure with the pointer and lead the surgical intervention to the preplanned and simulated result. With new developed soft and hard ware it is possible to guide the tip of any tracked surgical tool (drill, burr, chisel or for example endoscope) or to localize the focus of a surgical microscope.

Case Reports

The navigation system STN (Stryker-Leibinger) was used for alltogether 67 computer assisted procedures including tumor resections, orbital and midface reconstructions, optic nerve decompressions, distraction and orthognathic procedures, guided biopsies, endoscopic procedures and implant insertions. Based on CT- or MRI scans the surgical procedures were preoperatively planned and simulated and intraoperatively controlled using frameless sterotaxy as decribed above. On the hand of two clinical cases the use of navigational surgery for the insertion of zygomatic implants after partial maxillary resection shall be demonstrated. In the first patient primary insertion of a zygomaticus fixture was performed after resection of an anaplastic carcinoma of the right midface to achieve immediate support for an obturate prosthesis. (fig. 3). In the second case guided unilateral insertion of two zygomatic implants and one standard dental implant was performed to achieve permanent prosthodontic restauration after partial maxillary resection (fig. 4).

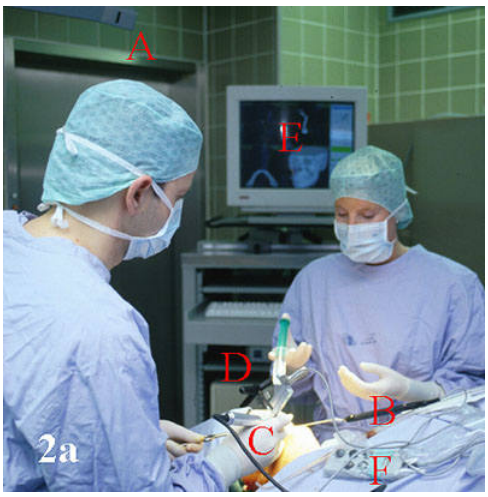

Fig. 2a: the cameras (A) receive signals of pointer (B) and drill (C). Tracking is performed with the DRF (D) fixed to a metal clamp. On the screen (E) and with the remote control (F) the surgeon controls the accuracy of any drilling procedure

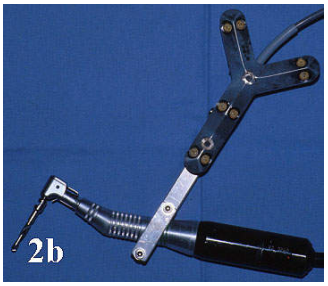

Fig. 2b: the position of the tip and the axis of the drill are detected through the LED's.

Fig. 2c: occlusal splint with markers for CT or MRI scans

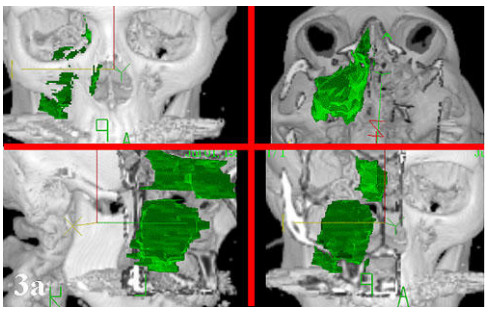

Fig. 3a: primary maxillary reconstruction after tumor resection. Dimensions of the anaplastic carcinoma only visible in the CT

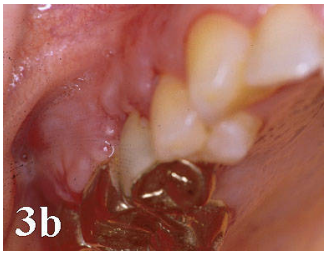

Fig. 3b: clinical view

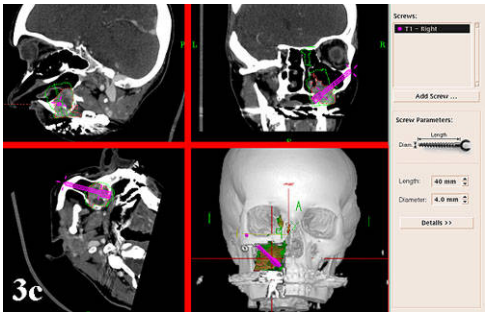

Fig. 3c: preoperative planning and simulation of radical resection and insertion of the zygomaticus fixture. After chemotherapy (red margins) the pretherapeutic tumor margins (green margins) were transformed into the data set to achieve radical resection

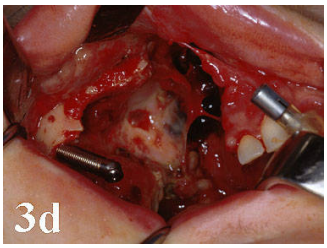

Fig. 3d: after resection navigational implant insertion was performed for immediate prosthodontic reconstruction.

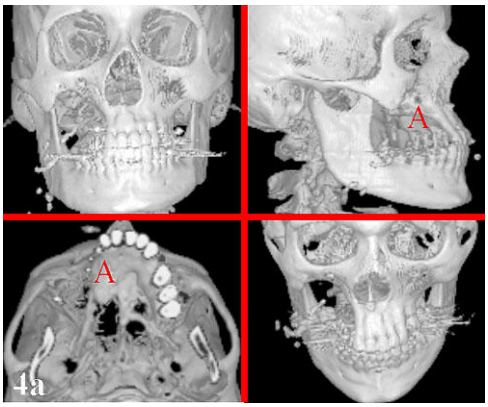

Fig. 4a: secondary reconstruction of the right maxilla with extensive bony defect.

Fig. 4b: clinical view.

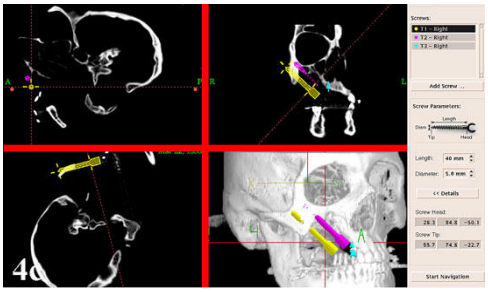

Fig. 4c: steel pins (A) inside the template and referencing splint simulate the ideal dental axis. Preoperative planning of the insertion of two zygomaticus fixtures (yellow and pink) and one standard dental implant (blue) was performed.

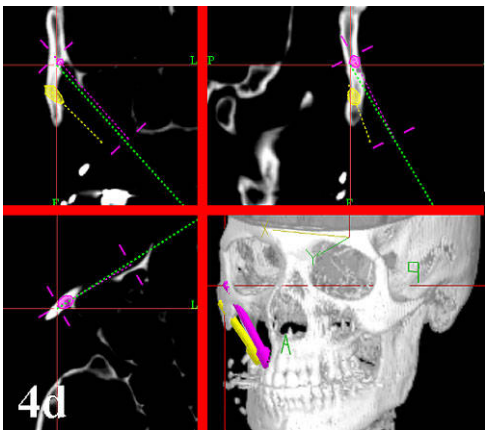

Fig. 4d: the screen shot during intraoperative navigation demonstrates parallel insertion of the second zygomatic implant.

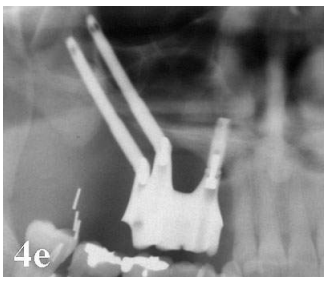

Fig. 4e: the postoperative panoramic view confirms the intraoperative informations.

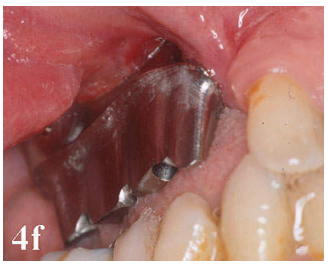

Fig. 4f: clinical view of the suprastructure before fixing the dental bridge.

Fig. 4g: prosthodontic reconstruction.

Discussion and Conclusions

The use of zygomatic fixtures after ablative tumor surgery with resection of the maxillary bone provides immediate prosthetic reconstruction without additional bone grafting. Computer assisted insertion of these implants improves preoperative planning by valid 3D visualization of the anatomic situs and virtually positioning of the fixture and faciliates clinical procedure by guiding the drill to the intended position.

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Abbreviations

CT = Computed Tomgraphy
MRI = Magnetic Resonance Imaging Kernspintomographie
STN = Surgical Tool Navigator

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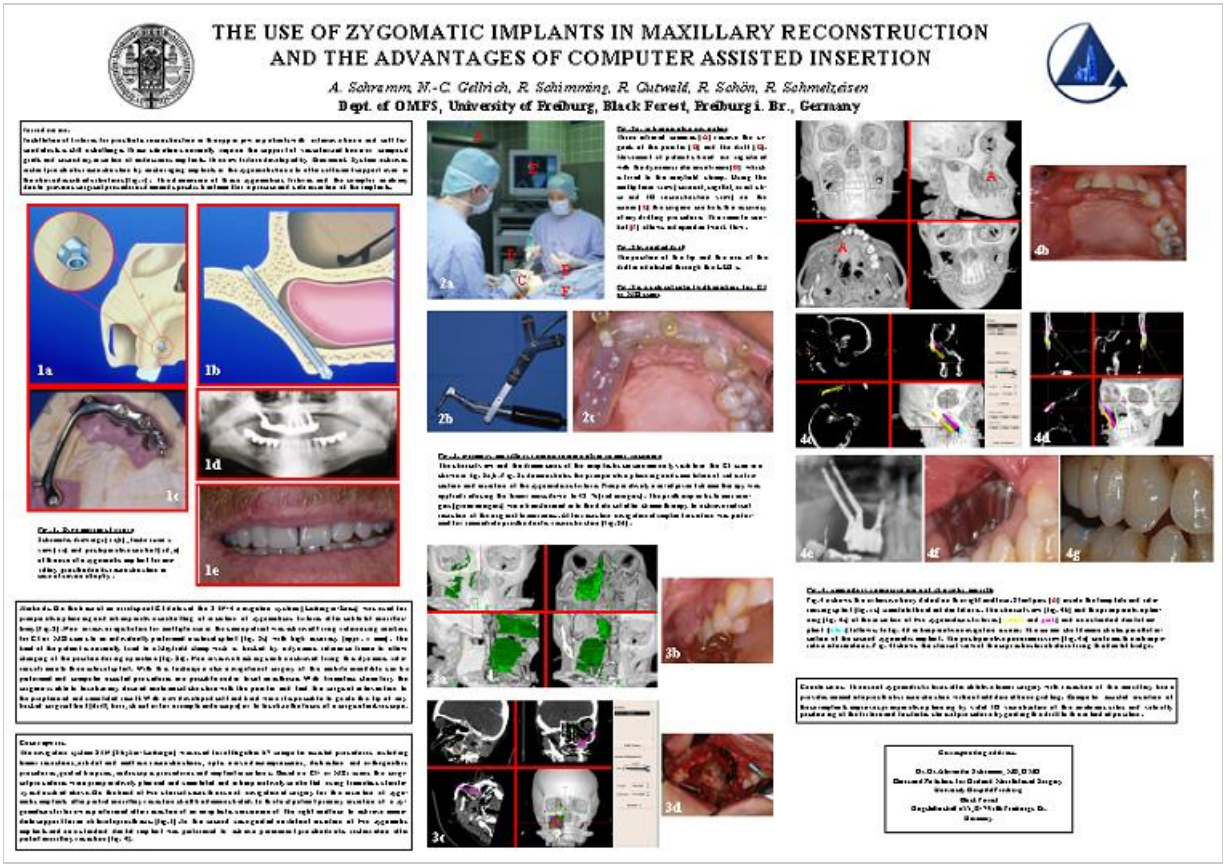

THE USE OF ZYGOMATIC IMPLANTS IN MAXILLARY RECONSTRUCTION AND THE ADVANTAGES OF COMPUTER ASSISTED INSERTION

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