

Letters to the Editor

Re: Patient-specific sub-periosteal zygoma implant for prosthetic rehabilitation of large maxillary defects after oncological resection

In the article by Vosselman et al., “Patient-specific sub-periosteal zygoma implant for prosthetic rehabilitation of large maxillary defects after oncological resection”¹, the authors did not make use of the piriform aperture frame, which otherwise would constitute two extra bony buttresses for solid screw fixation. Furthermore, the authors used a single implant. In 2011, I used a two-segmented sub-periosteal zygomatic implant in a 4-year-old patient with the same indications as those described in the recent report by Vosselman et al. (Figs. 1 and 2).

Because the right-sided implant was not supported vertically, shear forces and rocking caused it to fail, requiring replacement with a new one. The replacement implant was supported vertically, albeit weakly, by the palatal bone, which saved it from loosening again. The system has been functioning well now for 6 years since the revision surgery. The dentures have been remounted three times to keep up with growth (sagittal, vertical, and transverse).

My experience with that case subsequently led to the development of the concepts of the additively manufactured sub-periosteal jaw implant (AMSJI)². My experience has taught me several key lessons. First, always look for extra vertical support (e.g., from the palatal bone, which was not done in the case described by Vosselman et al.)¹. Second, as has also been advocated by Gellrich et al.³, use extra fixation on the paranasal buttresses whenever possible (these were available but not used in the case described by Vosselman et al.)¹. Third, make biofunctionalization towards



Fig. 1. Three-quarter maxillary defect in a 4-year-old child after resection of aggressive juvenile fibromatosis.



Fig. 2. Patient-specific titanium sub-periosteal zygomatic implants, with transgingival posts that cannot be detached from the endoprosthesis. This was the predecessor of the additively manufactured sub-periosteal jaw implant².

bone and soft tissues a priority (this was not addressed in the report by Vosselman et al.). Fourth, make it possible to disconnect each post from the basal loop in the event that peri-implant mucositis develops into peri-implantitis. In the demanding case described by Vosselman et al., it is likely

that loosening of the implant or peri-implantitis at one buttress will lead to failure and loss of the system.

Funding

None.

Competing interests

Dr Mommaerts is innovation manager at CADskills bvba.

Ethical approval

Retrospective study—not applicable.

Patient consent

Written consent was obtained.

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Differences in approach for sub-periosteal zygoma implant designs

We thank Dr Mommaerts for his comments on our technical note¹. We agree that maximal benefit should be taken from existing anatomical structures. However, in oncology cases such as the one we reported, with an extensive maxillary defect due to ablative surgery, there is a lack of such anatomical structures (Fig. 1). Moreover, most patients with large maxillary defects have been subjected to postoperative radiotherapy, which further challenges implant placement because of the inherent risk of developing osteoradionecrosis.

In the case presented, the volume, surface, and amount of perimucosal connection of the sub-periosteal zygoma implant design was not only prosthetic-driven, but also accounted for the minimal available bone remnants after a high resected maxillectomy and the fragility of the irradiated tissues. To deal with such a lack of anatomical support and compromised tissues, as well as our endeavours towards a slimmer and less voluminous single sub-periosteal zygoma implant (psSPI) design, we performed a finite element analysis (FEA) to ensure stable fixation of the psSPI to the available zygomatic bone. In addition, we applied locking screws to obtain en-bloc stabilization. This FEA approach indicated that no failure of the designed implant will occur within 1.75×10^7 loading repetitions, reflecting 25 years in vivo². Matching an 18-month follow-up computed tomography (CT) scan to the CT scan obtained directly postoperative revealed a maximum measured deviation of 0.44 mm (Fig. 2). This deviation includes errors of both CT scans (0.4 mm and 0.6 mm thickness),

segmentations, and superimposition of the models.

While Mommaerts used sandblasting, acid-etching, and plasma surface activation for the surface of his implant³, we opted for high-gloss, polished, milled titanium in order to ease intraoral cleaning. Moreover, as we used locking screws, we did not need osseointegration-promoting surface modifications. With regard to Mommaert's concerns with not using disconnectable posts, it is our opinion that the use of disconnectable posts would be of no added benefit and would even counteract the slim and less voluminous design we prefer for oncological cases. The latter because caution has to be taken in oncology cases when it comes to penetration of the compromised soft tissues, due to scarring and/or radiation injury. Therefore, we made the deliberate decision to minimize the amount of perimucosal connection and thereby reduce the risk of peri-implant mucositis developing. Furthermore, the FEA showed that there was no need for additional posts to increase vertical support, which is a great advantage in oncology cases in which the implant is placed in highly irradiated tissues. In the event of peri-implantitis occurring, there is a very high risk of developing osteoradionecrosis. The occurrence of osteoradionecrosis in our patient case would result in loss of the implant, with likely substantial bone loss and a maxillary defect that would be very difficult to treat.

To safeguard a good result, we have imposed strict hygiene recall appointments. Professional cleaning of the oral cavity and the implant during the recall visits, in addition to strict oral hygiene maintenance by the patient herself, will be of the utmost importance to prevent

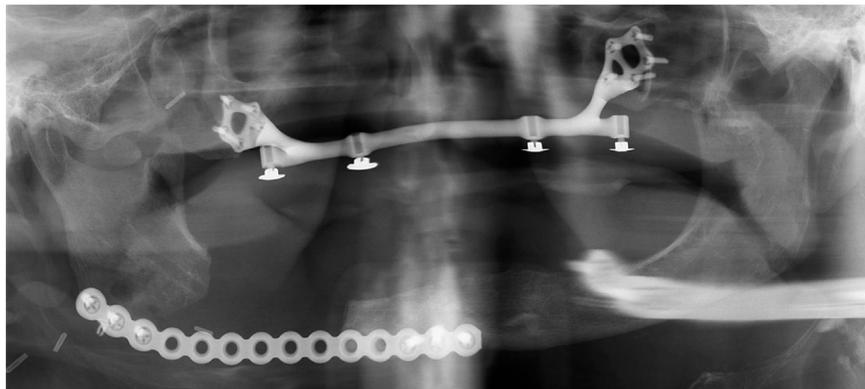


Fig. 1. Panoramic radiograph showing an extensive maxillary defect due to ablative surgery and a lack of anatomical structures to allow vertical support. To deal with the lack of anatomical support and compromised tissues, a finite element analysis was performed to design a slim, minimal volume sub-periosteal zygoma implant (psSPI) that can be reliably fixed to the remaining zygomatic bone.