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Technical note

Reconstruction of complex mandibular defects using integrated dental custom-made titanium implants

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Reconstruction of the craniofacial complex is challenging because of the unique anatomy, the presence of vital structures, and the diversity of defects. In craniofacial reconstruction, restoration of appearance and function is the primary goal. Autografts are the gold standard treatment,¹ but they have several disadvantages, which has led to research into alloplastic materials. The development of CAD/CAM systems allows for precise preoperative planning and design of patient-specific implants.^{2,3} The workflow of custom-made implants is shown in Fig. 1. Two-dimensional DICOM files were converted into 3-dimensional stereolithography (STL) files and the custom-made implant was designed using AB Guided 3-dimensional software (A.B. Dental, Ashdod, Israel). The skull and the implant were printed as an STL model in resin for compatibility tests using a 3-dimensional Objet260 Dental Selection printer (Stratasys[®], Rehovot, Israel). The titanium implant was then printed using a laser sintering 3-dimensional printer (EOS, Novi, MI, USA).

We present the case of a patient who had his facial bones reconstructed because of a large deficiency in the ramus,

body, and angle of his right mandible caused by an ameloblastoma.

After the resection, we discovered that the reconstruction plate had fractured and his mouth opening showed deviation of the mandible to the right. We planned a patient-specific titanium implant, which contained a crib with pores for better osseointegration of the autogenous bone graft. We added dental implants on the posterior mandible, at the sites of the first and second molars (Fig. 2). The robust structure of the crib protected the bony graft from pressure from the soft tissues and so prevented resorption.

The implant was inserted through the previous incision in the right submandible. A second team harvested a bone graft from the left anterior iliac crest, which was inserted into the crib together with xenograft bone replacement (Bio-Oss, Geistlich, Wolhusen, Switzerland) (Fig. 3). We put intermaxillary fixation in place intraoperatively and later converted it to elastics during his stay in hospital.

Postoperatively he showed accurate occlusion, symmetry of the face and mandible, and good function, which included adequate opening, closing, and lateral movements of the mandible with no deviation. He later returned for intraoral scanning (Carestream, Rochester, NY, USA) and custom-made screw-retained crowns that were produced by Dental Chakir, (Herzliya, Israel) (Fig. 4).

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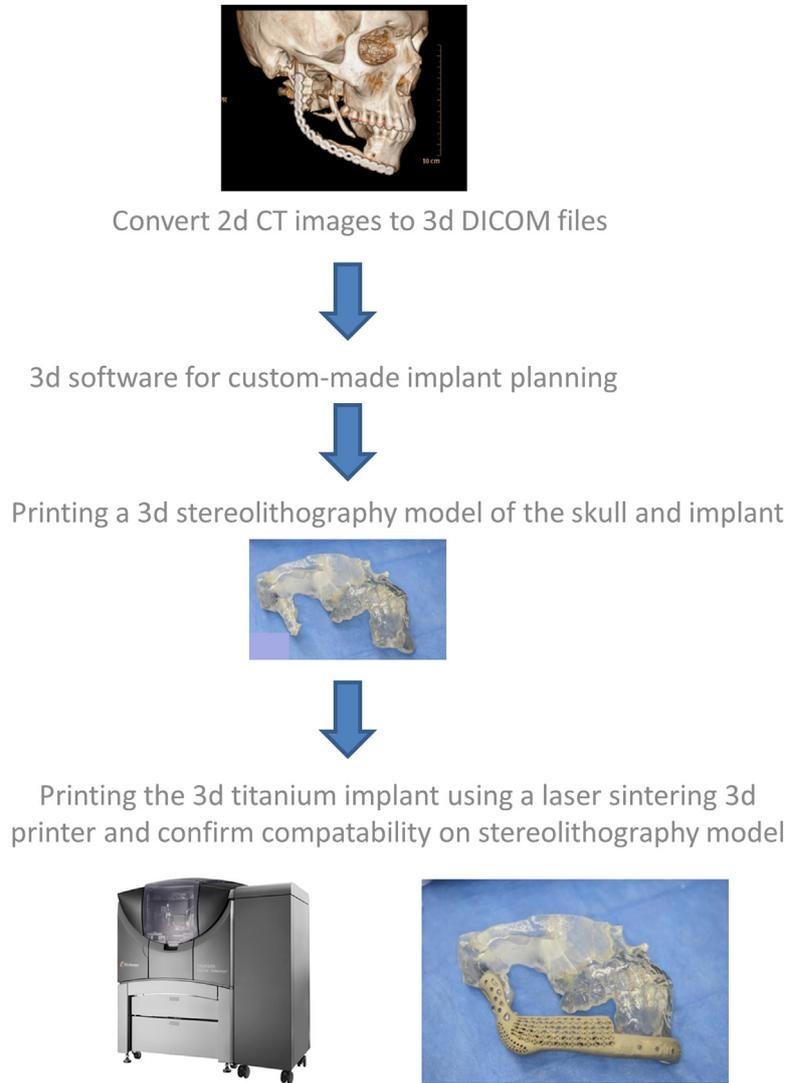


Fig. 1. A flow diagram showing the stages of the design and manufacture of custom-made, patient-specific implants.

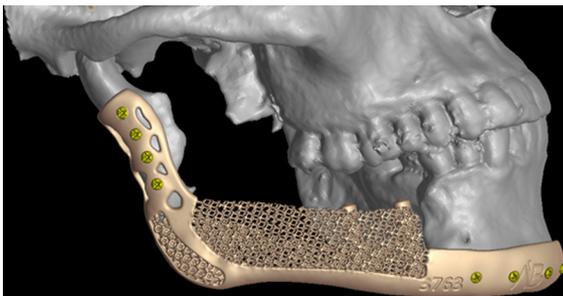


Fig. 2. Design of the custom-made titanium implant based on computed tomography. The implant was designed with maximum pores for better osseointegration. Dental implants were designed as part of the custom-made implant at the location corresponding to teeth 46 and 47.



Fig. 3. The second operation to insert the custom-made implant. The fractured plate was removed followed by fixation of the custom-made implant to the remaining mandible, ascending ramus, and body. Autogenous iliac crest bone graft and xenograft were put into the preplanned crib.

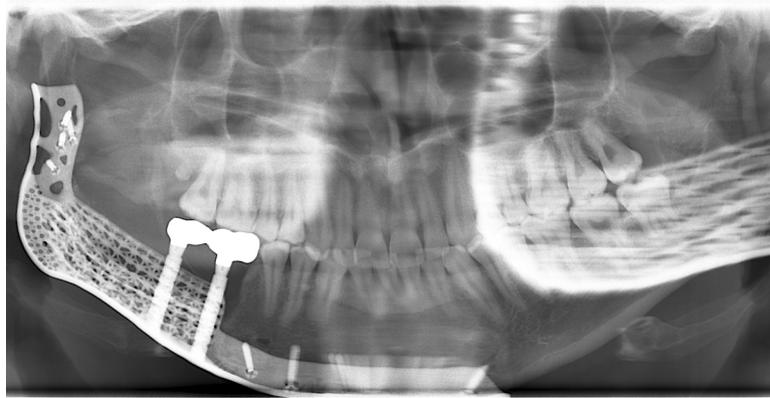


Fig. 4. Postoperative panoramic radiograph showing the patient-specific implant in place. Dental rehabilitation employed zirconia crowns on multiunit abutments, and the proper placement of the screw-retained crowns can be seen.

One-year follow up showed good function and appearance. He had a stable occlusion and mouth opening of 50 mm with no deviation.

The innovation of incorporating dental implants enabled a simultaneous mandibular reconstruction and dental rehabilitation by the same patient-specific implant. We agree with Kontio that the future of reconstruction will eventually be based upon a combination of 3-dimensional printing and tissue engineering.⁴

Conflict of interest

We have no conflicts of interest.

Ethics statement/confirmation of patient's permission

Approved by our institute's ethics committee. We obtained the patient's permission for all images used.

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