White Paper

Mandibular Reconstruction Using 3D-Printing Modeling Technology

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INTRODUCTION

Mandibular reconstruction can be challenging for the surgeon wishing to restore its unique geometry. Reconstruction can be achieved with titanium bone plates and autogenous bone grafting. Incorporation of the bone graft into the mandible provides continuity and strength required for proper aesthetics, function and permitting dental implant rehabilitation at a later stage. Precious time in the operating room is invested in plate contouring to reconstruct the mandible. The use of 3D-printing modeling enables accurate contouring of plates prior to surgery. Furthermore, this technology can be utilized during the second stage of reconstruction, in which a template is created for the harvesting of a bone implant.

Materials and Methods: A 27-year-old man suffering from left mandibular plexiform ameloblastoma, approximately 5.3 X 4.3 cm in size, extending from the distal root of tooth no. 36 up to the sigmoid notch. An 8 cm resection was planned with bone plate reconstruction in the first stage, and reconstruction with iliac crest bone graft in the second stage. CT imaging was performed on a 64-slice MDCT scanner (Brilliance 64, Philips Medical). Volumetric data was acquired (1 mm slice thickness, 0.5 mm increment, 0.75 s rotation time, 120 kVp, 50 mAs). DICOM data was converted to an STL format. A photopolymer jetting device (PolyJet™ Technology, Eden500V™, Objet Geometries Ltd, Rehovot, Israel) "printed" super-thin layers (down to 16 microns) of hard plastic and a gel-like support material at 600 x 600 dpi to create the model.

RESULTS

Excellent aesthetic and functional results with the prefabricated plate were achieved in a shorter operating time. Bone graft configuration was made according to the template, and positioned properly for planned dental implants.

CONCLUSION

3-D printing using Objet's PolyJet Technology is a promising method for precise mandibular reconstruction using bone plates and grafts, whereby operation time is shortened and the surgical procedure is made

Image 1: Marking of planned osteotomy margins, 1cm away from tumor, on the printed PolyJet™ model

Image 2: Adjustment of 'AO SYNTHES' titanium reconstruction plate (2.4mm) to the mandible prior to operation

Image 3: Marking of the planned approach to the tumor

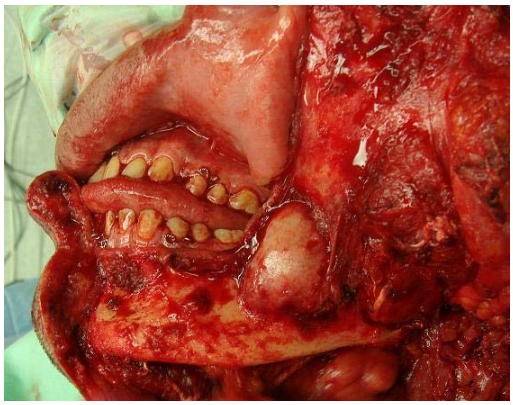

Image 4: Elevation of lower buccal cheek flap, exposing tumor on left body and ramus of mandible

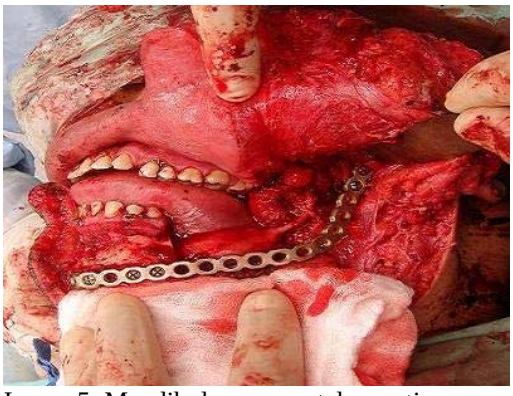

Image 5: Mandibular segmental resection, followed by adjustment of pre fabricated reconstruction plate to bridge the defect

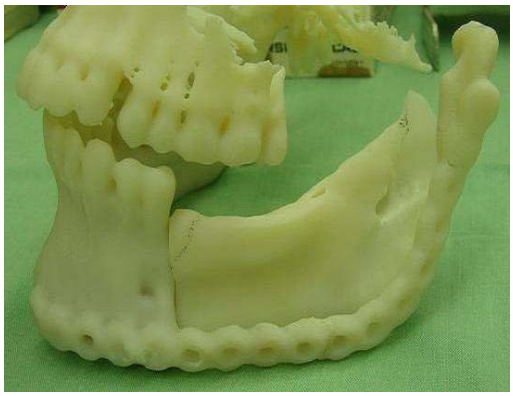

Image 6: In the second surgery phase prior to reconstruction of the mandible, a negative template of the gap was fabricated as a guide for proper bone graft design

Image 7: Bone harvesting from the iliac crest. The bone shape grafted was based on the printed PolyJet™ model.

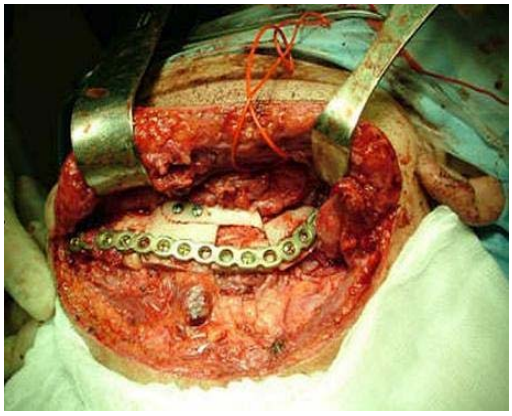

Image 8: Exposure of the gap bridged by the plate, and filling the defect with bone graft. Note the failure to adjust the bone graft as one piece according to the template created.

Image 9: Post operative x-ray of the reconstruction procedure

Image 10: Successful mandibular reconstruction using bone plates and grafts, whereby operation time is shortened and the surgical procedure is made easier