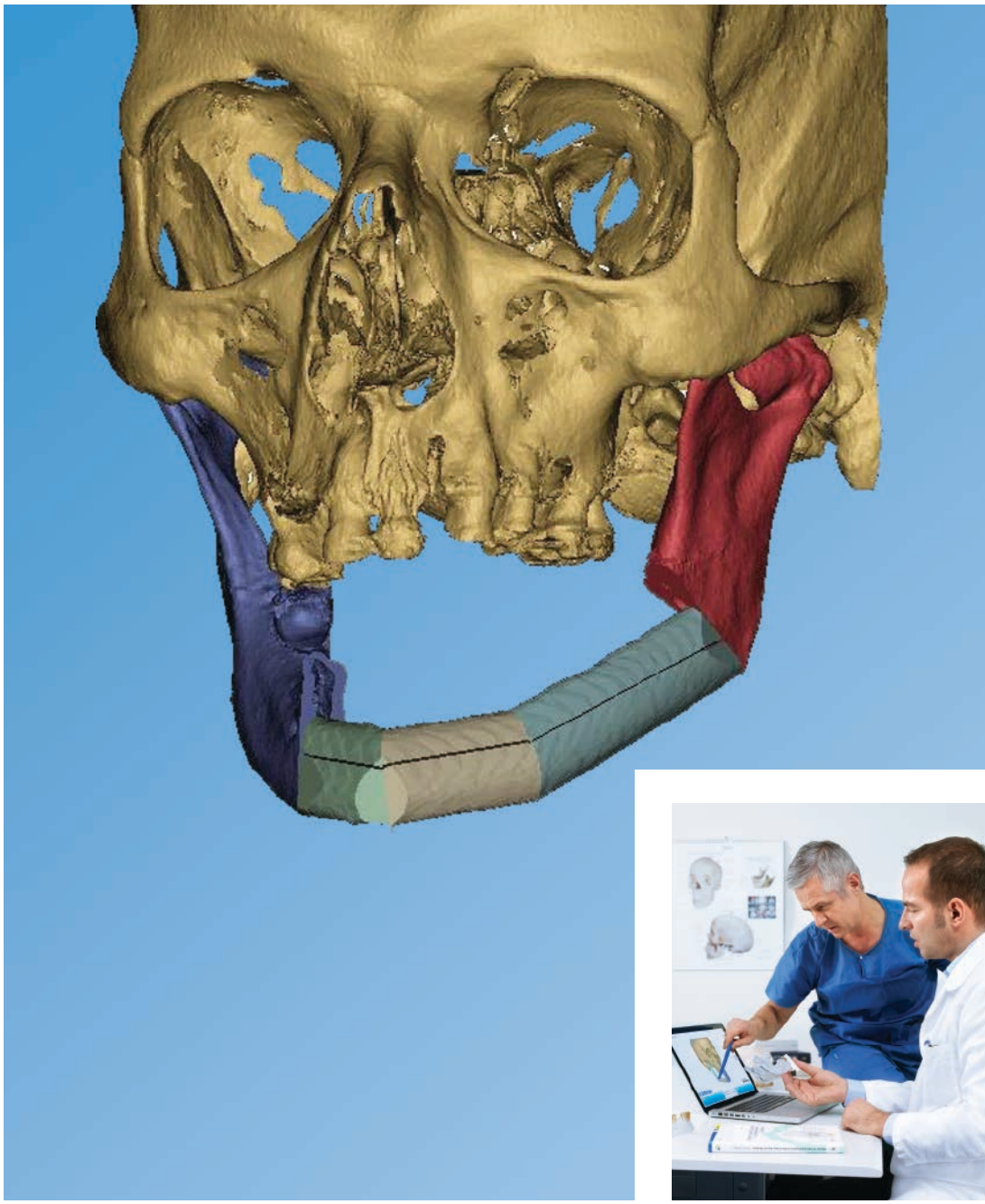
Reconstruction of a Mandibular Osteoradionecrotic Defect with a Fibula Osteocutaneous Flap. Using Synthes ProPlan CMF, Patient Specific Plate Contouring (PSPC) and the MatrixMANDIBLE Plating System.

Case Report



SYNTHES® CMF

Instruments and implants approved by the AO Foundation

Reconstruction of a Mandibular Osteoradionecrotic Defect with a Fibula Osteocutaneous Flap. Using Synthes ProPlan CMF, Patient Specific Plate Contouring (PSPC) and the MatrixMANDIBLE Plating System.

Patient Profile

The patient is a 63 year old male with a history of squamous cell carcinoma of the left floor of mouth which was treated with local resection, ipsilateral neck dissection, and post operative radiation therapy twelve years ago.

During his initial consultation, he complained of left mandibular pain and intermittent drainage from his left mental area. No recent history of facial trauma was noted but he reported a "crack" sound followed by pain while eating one week prior to office visit.

Clinical examination showed mandibular instability of the left parasymphyseal area, anesthesia in the distribution of the mental nerve as well as deviation of the chin to the left. Furthermore, extensive radiation damage was noted on the skin of the left neck and mandible area. Intra-oral exam revealed exposed bone on the left mandibular ridge as well as poor dentition with multiple caries and generalized periodontal disease.

His CT scan revealed a fracture of the left mandibular parasymphyseal area with significant areas of osteolysis involving the body of the left mandible and extending almost to the symphysis. Over-rotation of the left proximal segment as well as anterior displacement of the condylar head was observed. Furthermore, significant collapse of mandibular width was noted as seen by the displacement of the genial tubercle to the left of the sagittal midline. Figures 1–4.

Biopsies were taken to rule out malignant disease. Clinical impression of osteoradionecrosis was confirmed with no evidence of malignancy on histopathology.

Figure 1

Figure 2

Figure 3

Figure 4

Treatment Plan

In consideration of the previous radiation therapy and surgical entry, a free tissue transfer was necessary to ensure success of this reconstruction. A CTA of bilateral extremities was obtained to evaluate the potential of using the fibula as a reconstructive tool.

CT scans were uploaded into Synthes ProPlan CMF to create three-dimensional images for preoperative planning. The appropriate CT scanning protocol, as defined by Synthes ProPlan CMF, was followed for the maxillofacial and lower extremity scans. In this protocol the patient is aligned without a gantry tilt. The head is stabilized to prevent motion with the jaws slightly opened, with or without a bite block. A DICOM compliant scanner is required with parameters set for unidirectional, 1 mm slices supplied in CD or MOD media.

Preoperative Planning Session

Through a web-based meeting with a Synthes ProPlan CMF clinical engineer, the area to be resected was identified. The extent of the resection was characterized according to the radiographic findings, keeping in mind the three-dimensional morphology of the neo-mandible and length of segments of fibula to be used. The resection was planned from the left mandibular angle to just anterior of the right mental foramen in order to preserve sensation to the right lower lip. Figures 5–7.

Surgical guides were virtually generated and created using CAD-CAM technology. The distorted anatomy of the resected native mandible was then restored virtually to ensure appropriate position of the proximal and distal segments. The repositioned neo-mandible created a more normal occlusion with the mandibular dentoalveolar complex in preparation for osteointegrated implants. Figures 8–10.

Figure 5

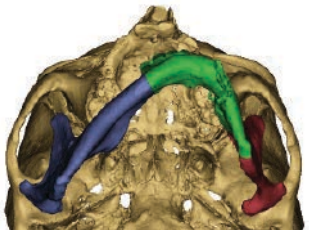


Figure 6

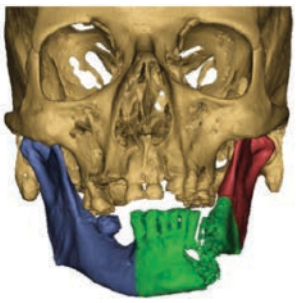


Figure 7

Figure 8

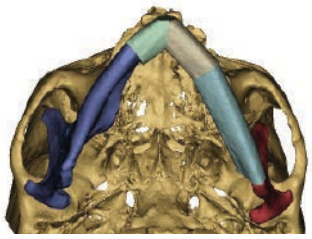


Figure 9

Figure 10

The right fibula was selected to reconstruct the mandible to allow for the vascular anastomosis to the right neck, away from the zone of injury and facilitate favorable inset of the skin paddle intra-orally. A three-segment fibular graft was planned to reconstruct the defect with the vascular pedicle running medially. Once the virtual contouring was completed, a patient specific surgical guide was generated to identify the location of the osteotomies. Figure 11. The distal osteotomy was placed 7 cm from the ankle to ensure stability of the joint while maximizing vascular pedicle length. A stereolithic model of the neo-mandible was created. A Patient Specific Plate Contouring (PSPC) plate was provided to match the contour of the neo-mandible. The precontoured mandible plate, mandible resection guide, fibula osteotomy guide, anatomic model and Case Report were provided preoperatively as a kit.

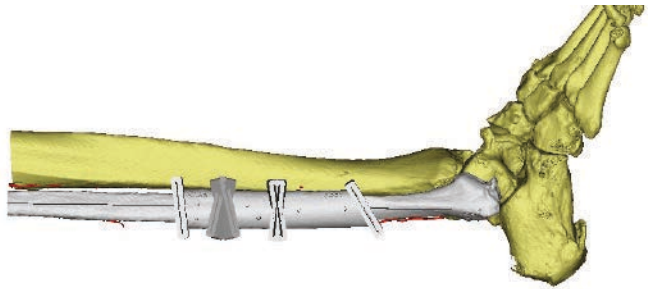


Figure 11

Intraoperative Surgical Details

Marking for an osteocutaneous right fibular free flap as well as a right anterolateral thigh flap were made pre-operatively. Figures 12–13. Due to the extensive post-radiation soft tissue damage and the required expansion of the soft tissue envelope following restoration of the skeletal anatomy, an anterolateral thigh flap was chosen to resurface the anticipated external skin deficit.

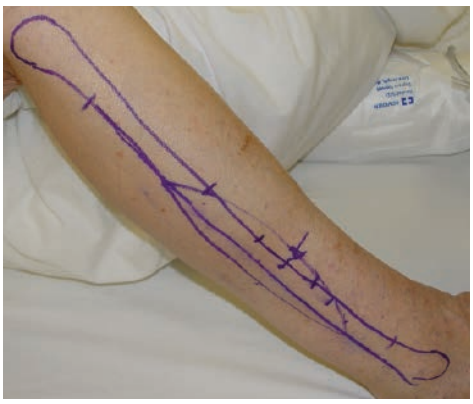


Figure 12

Figure 13

Access was gained through a cervical incision including excision of the fistulous tract. Once the mandible was accessed, the surgical guides were secured to the mandible using monocortical screws and the resection was performed with a sagittal saw. Figures 14–17, actual and virtual images. A right coronoidectomy was performed and the PSPC plate secured using bicortical fixation with 2.4 mm Titanium MatrixMANDIBLE Self-Tapping screws. Next, the right superior thyroid and facial artery were prepared for microvascular transfer along with the right external jugular vein and a branch of the internal jugular vein.

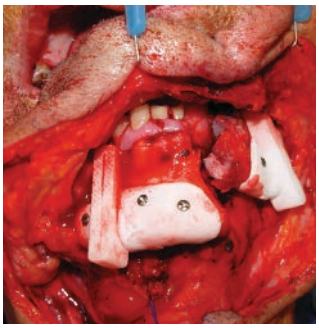


Figure 14

Figure 15

Harvesting Fibular Osteocutaneous Flap

The right fibular flap was harvested in standard fashion under tourniquet. A skin paddle of 10 X 4 cm was included to resurface the intra-oral defect created by the expansion of the soft tissue envelope, while allowing primary closure of the donor site. The harvested fibula was then taken to the back table and the surgical guide was secured to its lateral aspect using monocortical screws. Figure 18. The osteotomies were performed using a sagittal saw while protecting the vascular pedicle. The three segments were positioned on the PSPC plate according to the pre-surgical plan and fixated using 2.4 mm Titanium MatrixMANDIBLE Locking Screws. The intra-oral skin paddle was placed and microvascular anastomosis performed under microscope. An 18 X 8 cm anterolateral thigh flap was then harvested, inset at the left neck and revascularized without complication. Figure 19.

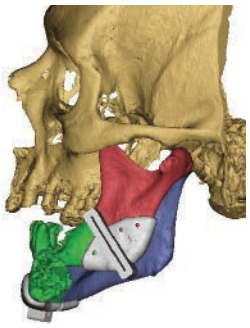


Figure 16

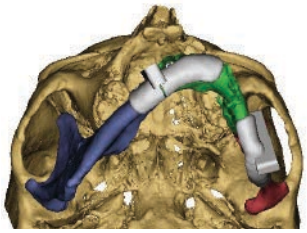


Figure 17

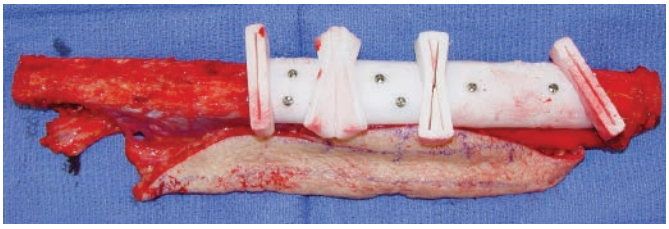


Figure 18

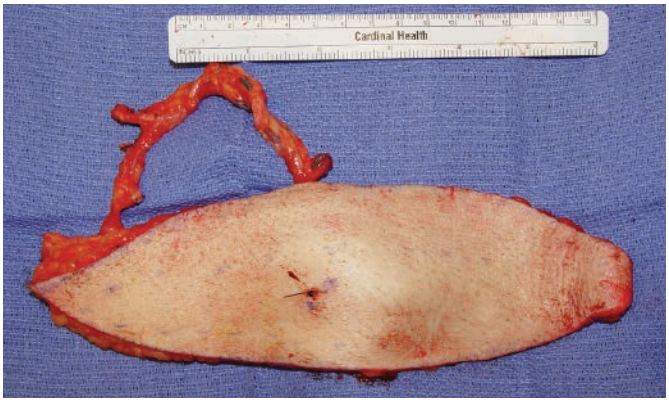


Figure 19

Reconstruction of a Mandibular Osteoradionecrotic Defect with a Fibula Osteocutaneous Flap. Using Synthes ProPlan CMF, Patient Specific Plate Contouring (PSPC) and the MatrixMANDIBLE Plating System.

Results

The patient did well post-operatively. At six months following his surgery, he underwent debulking and re-inset of the external anterolateral thigh flap. CT scans indicated good contour and union at all osteotomy sites. Accurate alignment of the patient's bone using Synthes ProPlan CMF ensured that the mandibular symmetry and function were restored as planned preoperatively. Figures 20–30 show the patient and compare post-operative 3D reconstruction models with virtual planning images.

Figure 20–Postop 3 months

Figure 21–Postop 6 months

Figure 22

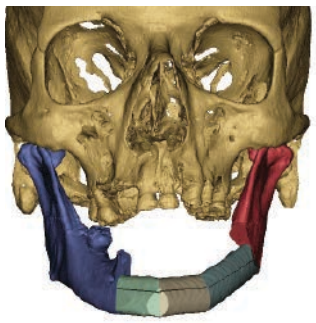


Figure 23

Figure 24–Postop 3 months

Figure 25–Postop 6 months

Figure 26

Figure 27

Figure 28–Postop 6 months

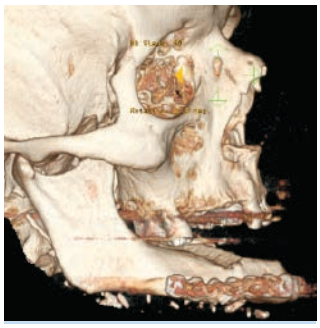


Figure 29

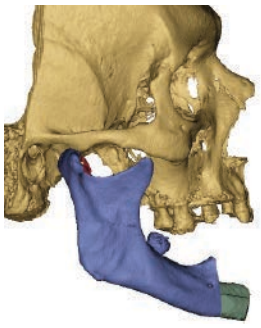


Figure 30

Figures 31–32 compare a post-operative segmental CT scan with its virtual planning image. In the CT scan, note the symphysis in the midline and radiographic evidence of bony union at the osteotomies.

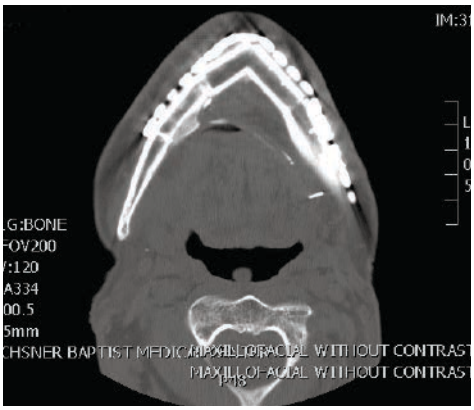


Figure 31

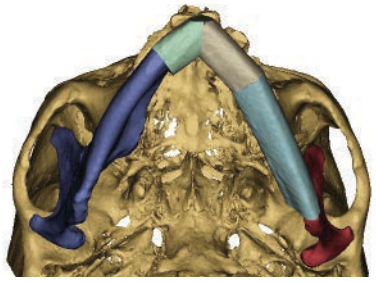


Figure 32

Discussion

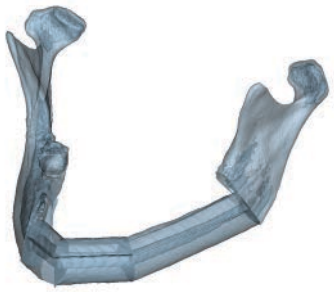
Osteoradionecrosis is one of the most devastating complications of head and neck cancer treatment. A tumor in the floor of mouth nearly doubles the rate of incidence. Whether or not a patient is a smoker and has poor immunologic and nutritional health at the time of treatment may also increase the risk.[1] The effects of therapeutic external beam radiation are chronic as well as progressive and lead to an hypoxic, hypovascular and hypocellular environment that decreases healing potential. Insult to the mandible, either from chronic infection, dental extraction or surgical entry may contribute to osteoradionecrosis in this patient population. Contemporary surgical management of osteoradionecrosis of the mandible involves radical debridement of non-viable bone with simultaneous reconstruction using well-vascularized tissue from a distant site. Often this debridement will be extensive to ensure healthy native mandibular margins.

The use of pre-operative virtual surgical planning allows restoration of normal skeletal anatomical contour and evaluation of the length of segments for the neomandible to ensure adequate vascularity to the reconstruction. The use of pre-fabricated cutting guides which identify the location of the closing osteotomies and a pre-contoured plate decrease operative time as it simplifies the reconstruction process.

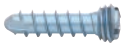
1 Chrcanovic BR, Reher P, Sousa AA, Harris M, Osteoradionecrosis of the jaws—a current overview—part 1: Physiopathology and risk and predisposting factors. Oral Maxillofac Surg, 2010 Mar;14(1): 3-16

Product Information

Osteotomy Guides and Model

SD900.231	Planned Outcome Model	
SD900.102	Fibula Guide	
SD900.101	Mandible Guide–Left	
SD900.101	Mandible Guide–Right	

Implants Used

SD449.510	Titanium MatrixMANDIBLE Angle Reconstruction Plate, 2.5 mm thick, 7 x 23 holes, left	
04.503.638– 04.503.648	2.4 mm Titanium MatrixMANDIBLE Locking Screws, self-tapping	
04.503.605– 04.503.618	2.0 mm Titanium MatrixMANDIBLE Locking Screws, self-tapping	

Surgeon Profile

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