

# Immediate Dental Implantation in Oncologic Jaw Reconstruction: Workflow Optimization to Decrease Time to Full Dental Rehabilitation

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**Summary:** Full dental rehabilitation following segmental mandibulectomy or maxillectomy for oncologic tumor ablation should be the goal for every patient. But despite advances in technology and reconstructive techniques, many patients do not achieve timely or complete oral rehabilitation. Recognizing this fault, we recently adopted an innovative workflow to increase the number of patients undergoing dental restoration, irrespective of tumor pathology or need for adjuvant radiotherapy. Preoperatively, every osseous jaw reconstruction undergoes virtual surgical planning to incorporate the placement of endosseous implants into the fibula osteocutaneous free flap. The dental implants are then placed intraoperatively at the time of tumor ablation and reconstruction. Four-to-six weeks following the initial surgery, the patient returns to the operating room for vestibuloplasty and exposure of the dental implants. Within 3 days of the vestibuloplasty, a temporary dental prosthesis is placed in the dental clinic, and the patient can then begin radiation therapy if needed. Following adjuvant radiation therapy, the temporary prosthesis can be replaced with a permanent one. At our institution, this innovative workflow has allowed for earlier aesthetic restoration of the jaw and greatly expanded the number of patients able to achieve oral rehabilitation. Herein, we describe this innovative workflow and provide technical pearls for successful execution. (*Plast Reconstr Surg Glob Open* 2019;7:e2100; doi: 10.1097/GOX.0000000000002100; Published online 14 January 2019.)

## INTRODUCTION

Dental restoration following segmental mandibulectomy for tumor ablation is germane to head and neck reconstruction and should be the goal for every patient. Nonetheless, despite advances in adjuvant treatments and reconstructive techniques, many patients do not complete dental rehabilitation.<sup>1</sup> Recognizing this deficiency, we have adopted an innovative workflow to increase the number of patients receiving dental restoration, irrespective of pathology, or need for radiotherapy.

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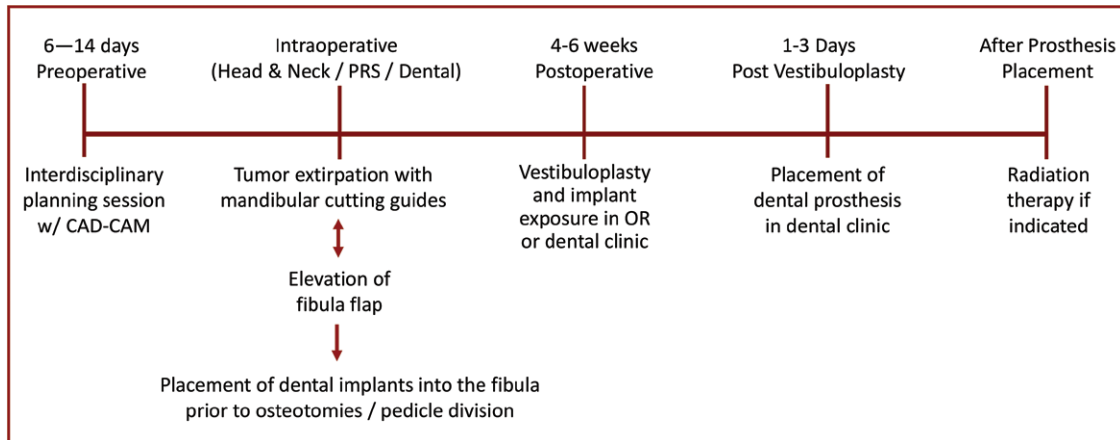
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Immediate placement of endosseous implants was pioneered by Urken et al.<sup>2</sup> to reduce the time required for dental rehabilitation and ensure early aesthetic restoration of the mandible. Levine<sup>3</sup> popularized the “Jaw In A Day” surgery, which places dental implants into the fibula flap concurrently following tumor ablation, mainly in the setting of benign tumors (eg, ameloblastoma). In contrast, for malignancies, concern has been raised about the potential for bone loss around the implants from radiation or compromise of the flap skin island needed for oral lining replacement; therefore, many institutions have elected to delay implant placement until a secondary procedure or after radiation.<sup>4,5</sup> The drawback of the latter approach is the protracted dental rehabilitation time, unpredictable nature of osseointegration following radiation, and increased risk for osteonecrosis of the jaw when placing implants into irradiated oral tissues.<sup>6,7</sup>

At our cancer center, a paradigm shift has occurred, due in part to the use of virtual surgical planning, toward immediate endosseous dental implantation at the time of fibula flap for mandibular or maxillary reconstruction. This approach has not only increased the number of

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**Fig. 1.** Workflow and timeline for dental rehabilitation in oncologic osseous jaw reconstruction. CAD-CAM, computer-aided design and computer-aided modeling; PRS, plastic and reconstructive surgery.

patients completing dental rehabilitation but also dramatically reduced the time to full functional recovery. Herein, a novel workflow is presented (Fig. 1) along with technical pearls for successful execution.

### WORKFLOW AND TECHNICAL TIPS

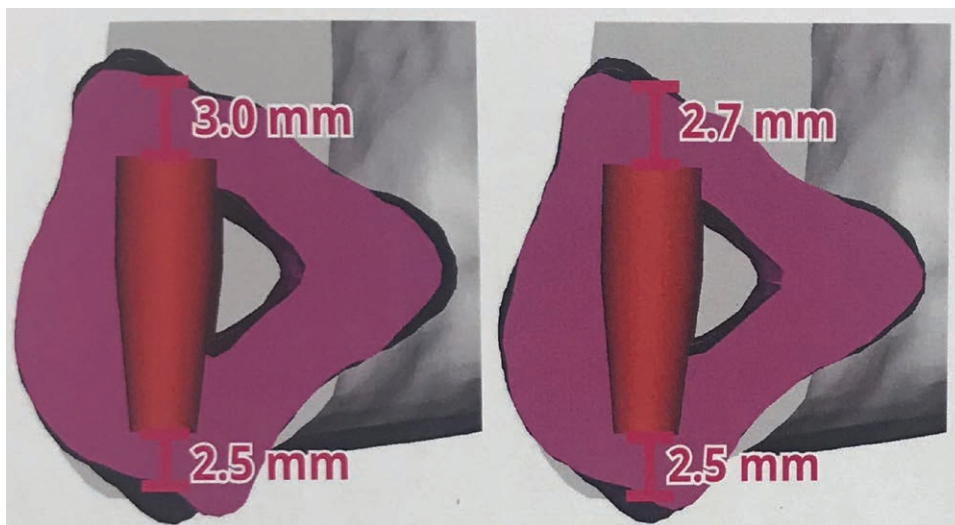
#### Preoperative Planning

All reconstructions are planned virtually via an online interdisciplinary meeting between the ablative and reconstructive surgeons and dental oncologist 6–14 days preoperatively. Bony resection is determined by the ablative surgeon to ensure adequate tumor margins. The reconstructive surgeon and dental oncologist then identify the position of fibular osteotomies and dental implants. To account for a skin island, the segment of fibula used for the reconstruction is selected by localization of the septal perforator(s) using a thin cut (1 mm) CTA of the lower extremity. Additionally,

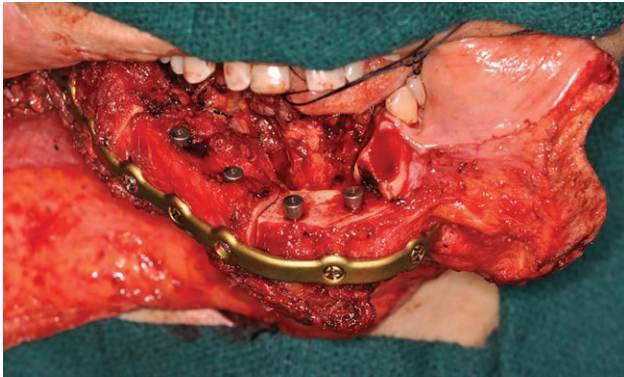
since fibula shape and size differs along its bony course, the anticipated area to be used must be identified so that appropriate dental implant size, profile, and trajectory are reflected in the fabricated fibula osteotomy guide. Specifically, fibula height and thickness are measured to determine the appropriately sized implant to engage both cortices with at least 1 mm of surrounding bone (Fig. 2). Implants should not be planned distal to the first molar to facilitate subsequent exposure and placement of the dental prosthesis. With adequate lead time, a prefabricated plate with predictive holes for the native jaw and/or fibula can also be fashioned, enabling precise placement of fixation screws around the implants. We have found the “double-barrel” technique unnecessary for dental rehabilitation, as the skin paddle bears potential to obstruct occlusion.

#### Intraoperative Execution

After the pedicle is isolated, but before division, the prefabricated fibula osteotomy guide is temporarily



**Fig. 2.** Virtual surgical planning diagram of dental implant placement into fibula flap. Depicted in cross-section are 3 dental implants, which must engage both fibula cortices with at least 1-mm of surrounding bone to ensure stability.



**Fig. 3.** An example of osteocutaneous fibula flap in situ with immediate endosseous dental implants following rigid fixation with a prefabricated reconstruction plate. Two dental implants were also placed into the native mandible. The fibula skin island was brought over the plate to cover the implants and resurface the floor of mouth and partial glossectomy defect.

adapted to the fibula. Accurate guide position, based upon the septal perforator position, must be verified, as even subtle changes can affect implant location and ultimately, occlusion. Osteotomy and dental implant locations are marked with a needle-point bovie, and the guide is removed. The area for dental implant placement is then freed of periosteum. In the areas with irregular topography, especially where a triangular portion of the fibula is used, the bone is burred to allow for a smooth, flat surface. Afterward, the fibula osteotomy guide is rigidly fixated, and the dental oncologist sequentially completes the implant osteotomies and places the endosseous implants. If both cortices are not engaged by the implant or the implant is otherwise unstable, it is removed and not replaced. The fibula osteotomies are performed, followed by removal of the osteotomy guide, and rigid fixation of the segments with mini-plates or a 2-mm reconstruction plate, taking care to avoid the implants.

Tumor extirpation occurs simultaneously with flap elevation. Prefabricated cutting guides, positioned based upon occlusion, are used to direct the osteotomies. Maintaining a singular plane for these osteotomies is essential, especially at the inferior border of the mandible, to allow for accurate positioning of the fibula construct on transfer. Once negative frozen sections are confirmed, the flap is harvested.

The fibula flap is brought to the defect and rigidly fixated to the native jaw (Fig. 3). Prefabricated occlusal splints are used to prevent axial rotation of the construct during inset, ensuring correct orientation of the dental implants for future prosthesis placement. The skin paddle is brought over the construct into the oral defect for inset, followed by microvascular anastomosis.

#### Postoperative Execution

Four-to-six weeks following initial surgery, vestibuloplasty is performed in the operating room or office to expose the implants and selectively debulk the flap skin island if necessary. Percutaneous access through the



**Fig. 4.** Postoperative photograph depicting the temporary dental prosthesis, which was placed 6 weeks following initial tumor extirpation and before radiation therapy. The fibula skin island is well healed.

skin paddle reveals the healing abutments, which are exchanged by the dental oncologist for definitive implant abutments with sterile protective caps to maintain patency through the skin island. The skin is closed around the base of the abutments to maintain their exposure. One to 3 days later, the protective caps are removed in an outpatient dental clinic and a temporary fixed dental resection prosthesis is placed (Fig. 4).

Following placement of the temporary prosthesis, patients can undergo radiation simulation and proceed with radiotherapy if indicated. Upon resolution of radiation-induced edema, the temporary prosthesis is exchanged for a permanent one.

## CONCLUSIONS

Since adoption of the current protocol, we offer every patient undergoing jaw reconstruction immediate endosseous implant placement as a means to rapid oral rehabilitation. Achieving the required technical accuracy and precision is possible only through the assistance of virtual surgical planning. The ability to reliably place implants before radiation has enabled us to provide consistent dental rehabilitation to a group of patients not previously able to benefit from this enhancement in health-related quality of life. Outcomes using this approach are forthcoming.

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## REFERENCES

1. Garrett N, Roumanas ED, Blackwell KE, et al. Efficacy of conventional and implant-supported mandibular resection prostheses: study overview and treatment outcomes. *J Prosthet Dent.* 2006;96:13–24.
2. Urken ML, Buchbinder D, Costantino PD, et al. Oromandibular reconstruction using microvascular composite flaps: report of 210 cases. *Arch Otolaryngol Head Neck Surg.* 1998;124:46–55.

3. Runyan CM, Sharma V, Staffenberg DA, et al. Jaw in a day: state of the art in maxillary reconstruction. *J Craniofac Surg.* 2016;27:2101–2104.
4. Ch'ng S, Skoracki RJ, Selber JC, et al. Osseointegrated implant-based dental rehabilitation in head and neck reconstruction patients. *Head Neck.* 2016;38:E321–E327.
5. Gürlek A, Miller MJ, Jacob RF, et al. Functional results of dental restoration with osseointegrated implants after mandible reconstruction. *Plast Reconstr Surg.* 1998;101:650–655; discussion 656.
6. Hundepool AC, Dumans AG, Hofer SO, et al. Rehabilitation after mandibular reconstruction with fibula free-flap: clinical outcome and quality of life assessment. *Int J Oral Maxillofac Surg.* 2008;37:1009–1013.
7. Wei FC, Santamaria E, Chang YM, et al. Mandibular reconstruction with fibular osteoseptocutaneous free flap and simultaneous placement of osseointegrated dental implants. *J Craniofac Surg.* 1997;8:512–521.