Mandibular Reconstruction With Vascularized Fibula Flap and Osseointegrated Implants: A Clinical Report

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Primary and secondary reconstruction of mandibular discontinuity defects with vascularized flap is currently the standard of care in many institutions. The most commonly used donor site for such flaps is fibula. Fibula provides enough bone length, allows 2-team approach, and has low donor site morbidity and abundant periosteal blood supply. The placement of endosseous implants in the vascularized fibula flap also facilitates functional dental rehabilitation. This clinical report describes the prosthetic rehabilitation and the complications of 2 mandibular discontinuity defects treated with vascularized fibula flap and implant-supported fixed prosthesis.

Key Words: mandibular discontinuity defect, vascularized flap, fibula, dental implant

INTRODUCTION

Historically, the goals in reconstruction of mandibular discontinuity defects are to provide architectural support to restore and preserve lower facial contour and occlusal relationships. The patients with unrestored mandible have cosmetic disfigurement, compromised function, and frustration with social functions.

A wide variety of methods have been reported for reconstruction of these defects. The osseous requirements for an optimal reconstruction include adequate bone length, consistent shape throughout the length of the bone, and adequate blood supply. Dental rehabilitation of the mandibulectomy patients could also present a difficult challenge for the prosthodontist. With increasing experience in mandibular reconstruction, the vascularized bone flaps proved to be superior compared to previous methods. Examples are osseomyocutaneous flaps, nonvascularized bone grafts, synthetic trays with cancellous bone grafts, or metal prosthesis.[1,2]

Vascularized rib was one of the earliest donor sites reported.[3,4] Since then a variety of other donor sites have been used, including ilium, radius, metatarsal, scapula,

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Presented at the joint meeting of the International Society for Maxillofacial Rehabilitation and the American Academy of Maxillofacial Prosthetics, Maui, Hawaii, October 12–15, 2006.
DOI: 10.1563/AAID-JOI-D-09-00066

and fibula. Each of these donor sites has significant limitations resulting from either length of available bone, the reliability of the associated soft tissue, or donor-site considerations such as undesirable location or the potential for significant morbidity.[5]

The use of fibula free flap in replacement of long bone in extremity trauma and cancer has been reported.[6,7] Hidalgo was one of the first to advocate the use of fibula in the mandibular reconstruction for discontinuity defects.[1,8] The advantages of fibula as a donor site are enough bone length available (25 cm) to reconstruct any length of the mandible, allowing a 2-team approach, low donor site morbidity, and abundant periosteal blood supply that permits multiple osteotomies.[8]

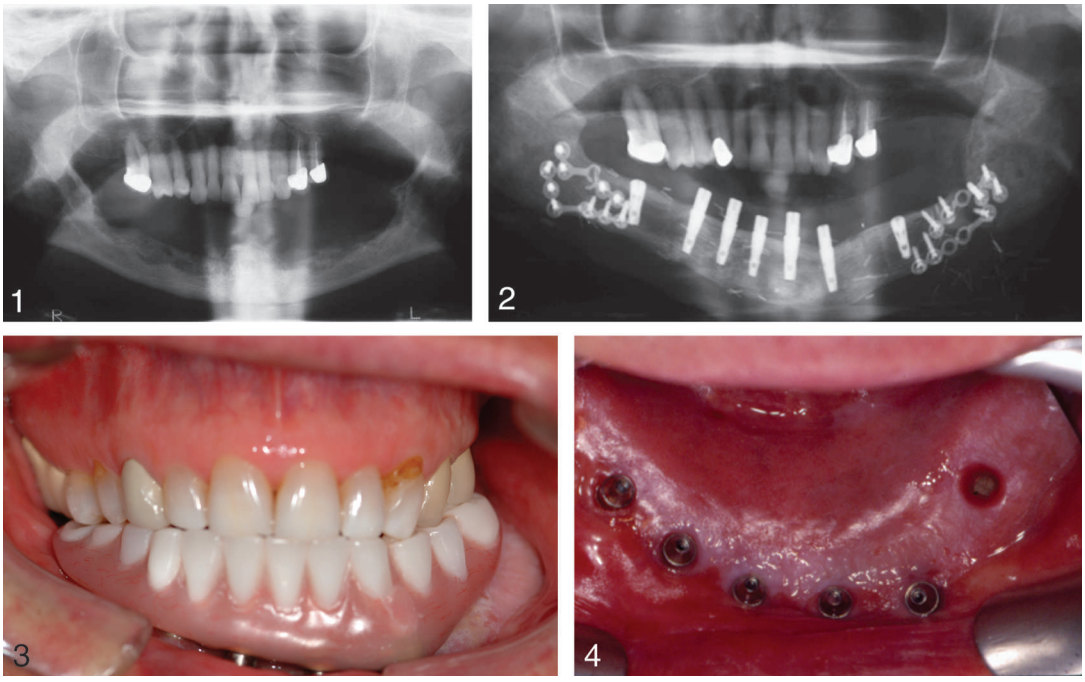
In a study of bone thickness in vascularized bone flaps, Frodel et al[9] reported iliac crest and fibula flaps having bone dimensions consistently adequate for placement of 10-mm long implants with fibula having the advantage of bicortical stabilization. In a more recent study, 52% of fibulae had adequate bone volume to place four 10-mm long implants.[10] In a morphologic and morphometric examination of 80 fibulae obtained from cadavers, the maximum width of fibular cross-section was 13.1 mm, and the maximal cortical thickness of fibula was reported to be 4.1 mm.[11] However, due to the limited diameter of the fibula compared to the height of the mandible, the vertical distance between the reconstructed segment and the occlusal plane could be large. There are reports of ''double-barrel'' fibular graft and osteogenic distraction to successfully increase the height of the fibula.[12–14]

In a review of 60 consecutive fibula free flap mandibular reconstructions, Hidalgo reported 59 successfully transferred flaps and 90% completely viable skin islands.[8] Osseointegrated implants were placed in 56% of the suitable patients and all integrated to the bone.[15] Comparing the postoperative and follow-up panoramic radiographs, Hidalgo reported minimal bone loss as measured by graft height over time. At both the midbody of the mandible and at the symphysis, 92% of the postoperative bone height was maintained (mandible range 71%–100%; symphysis range 77%–100%).[16]

Urken was the first to report dental rehabilitation by immediate placement of noncoated dental implants in 9 patients undergoing microvascular mandibular reconstruction.[17] All 24 titanium implants were osseointegrated following Albrektsson's criteria.[17] The advocates of the immediate implant placement propose this period would allow for osseointegration occurring undisturbed by the adverse effects of radiation, thus eliminating the morbidity associated with the placement of implants in irradiated tissues.[18] However, Roumanas et al[19] believe in delayed implant placement because it would facilitate a more desirable implant position. In a majority of the cases, implant placement was delayed 4 to 6 months to allow healing of the osteotomy site.[19]

In evaluating osseointegration of the endosseous implants in radiated vascularized fibula flap in conjunction with hyperbaric oxygen (HBO) treatment, Barber et al[20] reported 100% success during the 6-month follow-up for all 20 implants. The authors concluded vascularized graft and the use of HBO contribute to the successful osseointegration of the implants.[20] Chan et al[21] reported survival of 65 of the original 69 implants on a follow-up (range 6 to 84 months) in 17 reconstructed patients. All the failures were in an irradiated flap. Four implants were also converted to ''sleepers'' due to unfavorable position or inclination that presented a prosthetic problem.[21]

Urken et al[22] reported 96% success in reestablishing the mandibular continuity in reconstruction of 210 mandibular reconstructions. Three hundred sixty dental im-



Figures 1–4. Figure 1. Case 1 osteoradionecrosis of the mandible. **Figure 2.** Case 1 osseointegrated implants and abutment connection. **Figure 3.** Case 1 final prosthesis in occlusion. **Figure 4.** Case 1 implant alignment.

plants were placed between 1989 and 1997 with the overall survival of 92%. The survival rate was 86% in postoperatively irradiated bone and 64% in previously irradiated bone.[22] In a retrospective study of 24 patients who had undergone mandibular resection and reconstruction with fibula free flap, 19 implants had been placed in native mandible (3 in irradiated bone) and 81 in fibula. The overall 5- and 10-year cumulative success rates were 97% and 79%, respectively, with the mean follow-up time of 51.7 months (range 1.3 to 138 months).[23] Weischer and Mohr,[24] on a follow-up of 18 irradiated patients (83 implants) and 22 nonirradiated patients (92 implants) treated with mandibular reconstruction and implant-supported/implant-tissue–supported prostheses, reported a cumulative implant survival rate of 75% after 7 years for the irradiated group and 86% after 10 years for the nonirradiated group.

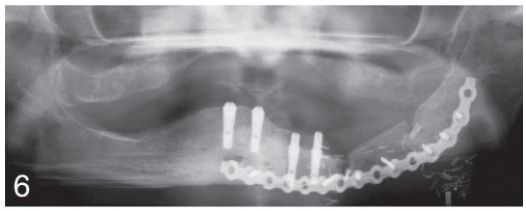
The long-term success rate of the fibula flap reconstructions, survival of osseointegrated implants, and prosthetic rehabilitation of reconstructed mandibles is extensively documented in the literature. The purpose of this report is to review the prosthetic rehabilitation and complications that occurred during prosthetic rehabilitation of 2 cancer patients who underwent mandibular reconstruction with vascularized fibula flap and endosseous dental implants.

Clinical Report

Case 1

Patient is a 62-year-old white man with a history of head and neck cancer of unknown primary. Subsequent to radiation therapy as the treatment of choice, the patient developed osteoradionecrosis in the anterior and bilateral posterior segments of the mandible and underwent mandibulectomy and mandibular reconstruction with vascularized fibula flap (Figure 1).

Clinical examination revealed partially edentulous maxilla and completely edentulous neo-mandible with altered anatomy.


Figures 5–7. Figure 5. Case 2 panoramic radiograph prior to implant placement. **Figure 6.** Case 2 osseointegrated implants and abutment connection. **Figure 7.** Case 2 abutment connection.

Mucosa was healed without any complications and moderate xerostomia was present. A limited interarch space on the right side and a crossbite on the left side were present between the maxillary teeth and edentulous neo-mandible. This was due to the difficulty in aligning and segmenting the straight fibula flap to the shape of mandible and estimating the adequate interarch space necessary during the surgery.

Seven dental implants (Astra Tech Inc, Waltham, Mass) (4.0 × 11 mm) were placed in the reconstructed mandible and in the widest segments of fibula flap (Figure 2). As a result of altered mandibular arch shape, reduced prosthetic space available between the maxillary right posterior teeth and the edentulous reconstructed mandible, and the difficulty obtaining access to the most distal implant, the mandibular prosthesis was only supported with 6 implants (Figures 3 and 4). The buccal positioning of the implants resulted in lack of keratinized gingiva around the implants and a reverse occlusion appearance of the mandibular prosthesis.

There was no sign of any prosthetic and implant complication in clinical follow-up. There was also no evidence of recurrent disease.

Case 2

Patient is a 62-year-old African American woman with history of squamous cell carcinoma of the floor of the mouth. The patient underwent left partial mandibulectomy followed by concomitant chemotherapy and radiation therapy. Subsequently, mandibular discontinuity was restored with the vascularized fibula flap on the left side (Figure 5).

Clinical examination revealed complete maxillary and mandibular edentulism with reduced mandibular range of motion. Mucosa was healed without any complications and moderate xerostomia was present. Four implants (4.0 × 11 mm) (Astra Tech Inc) were placed in the fibula flap and the remaining mandible (Figures 6 and 7). Upon uncovery and on clinical and radiographic evaluation, all implants were osseointegrated. However, as a result of buccal inclination of the coronal portion of the fibula flap, the endosseous implants had to follow the direction of bone. Upon trial and fabrication of the fixed prosthesis, the abutment screws had access through the left buccal flange of the prosthesis (Figure 8). The patient had also received a complete maxillary denture (Figure 9). There is currently no evidence of recurrent disease and no sign of any prosthetic and implant complications.

Discussion

There are various retrospective studies and clinical reports that indicate vascularized fibula flap in combination with endosseous implants could be a viable treatment option

Figures 8 and 9. Figure 8. Case 2 occlusal view of the final prosthesis. **Figure 9.** Case 2 final prosthesis in occlusion.

in the functional dental rehabilitation of mandibular discontinuity defects.[1–24]

In a 2-year follow-up of the patients in this clinical report, there was no sign of complications with vascularized fibula flaps during the postoperative and follow-up periods.

Critical to prosthetic reconstructions is the attainment of an arch form that is coordinated to the maxilla. The microvascular fibular transfer could be problematic in this regard. The straight shape of fibula and height/width mismatch between the fibula flap and the remaining mandible could cause difficulties in segmenting, aligning, and fitting the fibula flap in the mandibulectomy site. It can leave nonunions and defects in the graft and the graft invariably could lie too lingual for prosthetic needs.[25,26] These factors further complicated the design and fabrication of the implant-supported prostheses in patients of this clinical report.

Computerized tomograph (CT) scans of the head and neck are used regularly as a preoperative study for many patients to evaluate their disease. Some additional cost may be incurred if a dedicated CT study is ordered separately to make the stereolithographic model, and surgical fixation templates could be adapted presurgically. An accurate template, which is fabricated on the stereolithographic model, could lead to precise fibula shaping and concomitant reduction in operating time while maintaining mandibular alignment throughout the reconstructive process.[27]

Both patients in this report showed no episodes of prosthetic screw loosening/fracture. There was also no clinical and radiographic sign of any implant complication. Patients are currently on a 3-month follow-up schedule.

Abbreviations

CT: computerized tomography
HBO: hyperbaric oxygen

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