

# Osseous Changes Over Time in Free Fibular Flap Reconstruction in the Head and Neck



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## Abstract

**Outcome Objective:** To evaluate bone resorption in free fibular grafts and document resorption behavior as compared to dentulous and edentulous autochthonous mandibular bone.

**Methods:** A retrospective review was performed of all patients with a history of head and neck cancer requiring resection with subsequent reconstruction utilizing fibular free flaps between 2006-2016.

**Results:** Rate of atrophy was greatest in the edentulous mandible. Fibular grafts showed greater stability particularly with native dentate mandible.

**Conclusion:** Long term viability of both fibular flap and native mandible may be dependent on dental implantation to promote retention of bone stock and overall osseous stability.

## Introduction

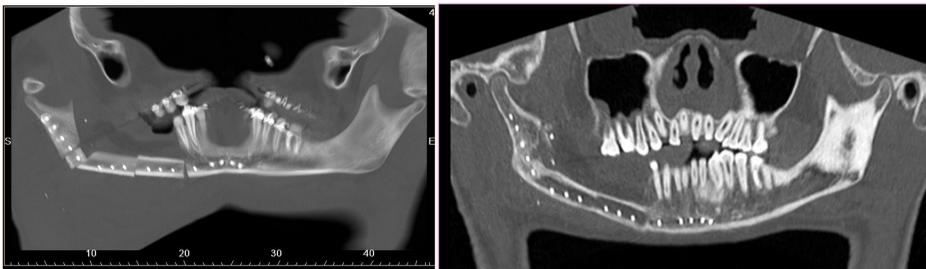
Segmental resection of the mandible due to oral cavity cancer leaves considerable deficits in both function and aesthetics. Therefore, in order to restore these components, expeditious reconstruction utilizing composite free vascularized free flap is often implemented. Documented success rates of 95% have been reported for vascularized free flaps in reconstruction of the mandible. However, studies addressing the long-term osseous changes to flaps have been lacking. Osseous changes and long term bony regression of the native mandible with aging is a normal occurrence. The extent of osseous deterioration in free flap reconstruction of the mandible, particularly in comparison to native mandibular regression, remains unclear. Although both donor and recipient site complications have been well studied, long term assessment of these patients is lacking. Prior studies have attempted to document atrophic changes following mandibular reconstructive but none have specifically evaluated temporal changes in parameters including width or cortical thickness of fibular graft in comparison to autochthonous mandibular bone. In this retrospective study, we examine the extent of bony resorption in hopes of better documenting the extent of osseous change within Fibular free grafts.

## Methods and Materials

A database query using CPT codes of the electronic medical record was used to identify all subjects who had undergone fibula free flap reconstruction of the mandible from 2006 to 2016. Only patients with a follow-up of at least 6 months were included in this study. Post-operative CT imaging for these patients was then reviewed to assess for mandibular atrophy. This query was approved by the Pennsylvania State University- Hershey Medical Center Institutional Board Review.

Post-operative Computer Tomography (CT) images were used to evaluate osseous atrophy and estimate a rate of bone loss per month. Fibular graft resorption was compared to corresponding sites along either the dentulous or edentulous mandible. Bone height, width, as well as cortical thickness were measured at corresponding locations along the fibula reconstructive site as well as the native mandible. Cortical thickness was measured along the superior and inferior margins of the mandible. The reconstructive segment was noted according to Jewer's classification<sup>1</sup> by bone defect type: H= hemimandibulectomy including condyle, L=Lateral segment without condyle, C= Central segment including canine teeth.

Statistical evaluation of resorption rate was performed using paired t-test. A value of  $p < 0.05$  was set as the level of statistical significance.



(Left) Panorex following fibula free flap reconstruction of the mandible.  
(Right) Follow up imaging at 14 months showing thinning of the cortical bone.

## Results

A total of 18 patients that had undergone free fibula grafts to the head and neck were identified on initial review of the medical record. These patients had follow up with imaging, which was reviewed retrospectively. Patients without follow-up or post-operative imaging were excluded. Follow up ranged from 6 to 59 months (average of 22.3). Mandibular defects were classified using Jewer's classification and included 9 LC (50%), 2L (11%), 2LCL(11%), 3HC (16.7%), 1C, and 1H (5.6%). Osteotomy site fractures, malunion, or nonunion were not found in any patients.

The average interval loss of osseous height from the time of reconstruction to subsequent follow up imaging was  $0.23 \text{ mm/year} \pm 0.27 \text{ mm/year}$  for the fibula flap,  $0.55 \pm 0.56 \text{ mm/year}$  for dentulous native mandible, and  $0.98 \pm 1.1 \text{ mm/year}$  in edentulous native mandible. Change in osseous width was  $0.19 \pm 0.26 \text{ mm/year}$ ,  $0.55 \pm 0.64 \text{ mm/year}$ , and  $0.73 \pm 0.86 \text{ mm/year}$ , respectively. Rate of superior cortical resorption was  $0.33 \text{ mm} \pm 0.40 \text{ mm/year}$  in fibular graft with resorption rates of  $0.35 \pm 0.4$  and  $0.53 \pm 0.66 \text{ mm/year}$  in dentulous and edentulous mandible. Inferior cortical resorption rates were quantified as  $0.30 \pm 0.34$ ,  $0.35 \pm 0.41$ , and  $0.51 \pm 0.63 \text{ mm/year}$  for fibula, dentulous, and edentulous mandible.

A trend in bone resorption was observed with greater atrophy in native bone, with the greatest rates of resorption in those with edentulous native mandibles. Fibular grafts showed more stability, in terms of lower overall atrophy rates, when compared to both dentulous and edentulous autochthonous mandible ( $p < 0.0001$ ).



## Discussion

Use of free fibula graft is often cited as the method of choice in reconstruction of the mandible, particularly when a cutaneous island is required.<sup>2-3</sup> In contrast to the significant bone resorption of onlay bone grafts, and native edentulous mandible our study indicates that fibular grafts provided stability, both with respect to bone height and weight. Our study not only confirms retention of fibular graft height, corresponding to prior observations<sup>3-6</sup>, but indicates that edentulous bone displays much higher rates of atrophy when compared to dentulous mandible. Our data indicates that dentition is a significant prognostic factor in maintaining bone stock and reducing overall atrophy. Additionally, no prior studies quantify cortical resorption rates in patients undergoing fibular reconstruction of the mandible. The thickness of cortical bone facilitates bicortical anchorage of dental implants. This results in higher removal torque, a biomechanical measure of osseointegration<sup>7</sup>. These results indicate that osseointegrated dental implants can, and should, be inserted into fibular bone in order to decrease resorption and promote stability as edentulous segments show increased rates of atrophy.

## Conclusions

Fibula free flap reconstruction of the mandible provides excellent functional results and allows for stable outcomes. Bone resorption is significantly lower in fibular graft compared with both edentulous and dentulous mandible. Edentulous bone displays significantly increased rates of atrophy in comparison to the dentulous mandible and therefore long term viability of both fibular flap and native mandible may be dependent on dental implantation to promote retention of bone stock and overall osseous stability.

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