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Use of Dentoalveolar and Zygomatic Implants in Restoration of Maxillary Defect Following Fibula Free-flap Reconstruction Failure

A Case Report

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ABSTRACT

Oral cancer resections cause tissue defects which result in functional complications, such as masticatory dysfunction, dysphagia, articulation and phonation issues. When the defect involves the maxillary arch, obturation is needed, either surgical or prosthetic. In cases where surgical procedures become ineffective, prosthetic options could be challenging.

This is a case of a 78-year-old male with the diagnosis of squamous cell carcinoma of the right alveolar ridge. The patient underwent partial maxillectomy and right neck dissection with fibula free-flap reconstruction of the maxillary arch. Despite a positive doppler reading, the fibula free flap became nonvital seven days postoperatively. At the time of removal of the non-vital flap, two osseointegrated dentoalveolar endosseous implants were placed in the remaining maxilla, and a defect/adhesive-retained edentulous interim obturator was fabricated. Because of the size of the defect, with only approximately 20% of remaining maxillary arch (Aramany Class IV, Okay Class III), prosthetic obturation was extremely difficult due to lack of retention and support from the defect side.

The patient was brought back to the operating room for placement of two zygomatic implants on the defect side. To enhance the success of the zygomatic implants and the patient's function in the interim phase, a fixture-level impression was made in the operating room to fabricate an interim bar, splinting all implants and providing retention for an immediate interim obturator prosthesis. Once the implants were healed and integrated, a definitive implant bar was fabricated to splint all implants and to ideally be placed within the confines of the prosthetic reconstruction. A locator-retained, implant bar-supported definitive obturator was fabricated. The patient was successfully prosthetically obturated with no evidence of nasal regurgitation or hypernasal speech.

This case demonstrates the prosthetic possibilities when surgical obturation is contraindicated or unsuccessful.

Malignant tumors of the maxilla often require removal of the lesion, along with extensive resection of surrounding tissue. The maxillary defect that results from the ablative surgery offers a variety of restorative challenges and alter-

ations in the patient's quality of life.^[1] In cases where an oronasal communication is present due to surgical resection, most patients will have masticatory dysfunction and dysphagia, along with articulation and phonation issues.^[2] Surgical obturation, by way of distant vascularized free-flap reconstruction, most commonly fibular free-flap (FFF),^[3] has the advantages of immediately closing the oronasal or oroantral communication, providing osseous structures for implant placement and decreased dependence on a prosthesis. These surgical procedures have the potential to fail secondary to thrombosis at the microvascular anastomotic site, wound infection, wound-edge necrosis and a variety of other complications.^[3] When failures occur or are expected, prosthetic obturation is necessary to aid in the surgical reconstruction to bring the patient closer to preoperative physiological functions.

An obturator is a type of prosthesis that restores separation between the sino-nasal and oral cavities, allowing for restoration of speech, swallow and masticatory function.^[4] In cases where cancer ablation requires removal of these structures, implants can significantly aid in the stability, retention and support of the obturator prosthesis.^[5-8] When alveolar bone is largely missing, remote osseous beds, such as zygomatic arches, can be used for implant placement. The use of zygomatic implants in the oncologic patient has been widely discussed in the literature as effective and, at times, the only option for successful prosthetic rehabilitation.^[5,9-12]

This report describes the post-maxillectomy prosthetic rehabilitation of a patient utilizing an obturator prosthesis with retention in the form of zygomatic and dentoalveolar implants after fibula free-flap failure.

Case Report

A 78-year-old Caucasian male was referred to the Oral Oncology and Maxillofacial Prosthetics Department at Erie County Medical Center (ECMC) by his general dentist, who observed an exophytic mass of the right maxilla extending to the midline and hamular notch. A biopsy was performed with resulting pathology consistent with invasive non-keratinizing squamous cell carcinoma, p16 negative. The patient underwent oral partial maxillectomy and right neck dissection with fibula free-flap reconstruction. Despite a positive doppler reading during fibula resection, the fibula free flap became nonvital seven days postoperatively. The patient was immediately brought to the operating room for removal of the nonvital flap and placement of two osseointegrated dentoalveolar endosseous implants (*Astra Osseospeed EV, Dentsply Sirona*) into the remaining left maxillary segment.

A clear acrylic (*Orthoresin Clear, Great Lakes Orthodontics*) immediate surgical obturator was placed and retained by a screw in the left hard palate.

Ten days postoperatively, the patient presented to the Maxillofacial Prosthetics Clinic for removal of the obturator and surgical dressing. The maxillary defect was cleaned with a 50:50 mix of chlorhexidine gluconate and hydrogen peroxide. An impression was made using irreversible hydrocolloid (*Jeltrate Alginate-Fast Set, Dentsply Sirona*), and an interim obturator was fabricated and inserted by the maxillofacial prosthetics team the same day. Limited retention was present from tissue undercuts and utilization of denture adhesive on the remnant left maxilla, as the dentoalveolar implants could not be utilized until osseointegration had occurred. With only approximately 25% of the maxillary arch remaining (Aramany Class IV, Okay Class III),^[4,13] treatment options were discussed with the patient to include zygomatic implants for bilateral support and retention for the final prosthesis.

The patient was brought back to the operating room by the head and neck surgeon and maxillofacial prosthetics team for placement of two zygomatic implants (*NobelZygoma 45° 42mm and 35mm, Nobel Biocare*) into the zygoma on the defect side (Figure 1). At this time, the dentoalveolar implants in the remaining maxillary alveolar bone were exposed to the oral cavity, and transmucosal stud attachments (*Locators, Zest Dental Solutions*) were placed on the implants. Attachment housings were incorporated into a new interim obturator with fast-set autopolymerizing acrylic (*Unifast Trad Live Pink, GC America Inc.*) and relined using Coe-Soft (*Coe-Soft, GC America Inc.*)

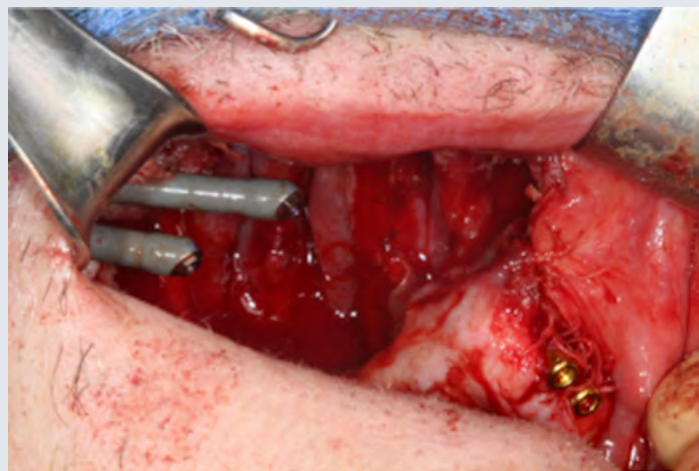


Figure 1. Surgical placement of zygomatic implants.



Figure 2. Locator-retained interim obturator #1 relined with Coe-Soft.

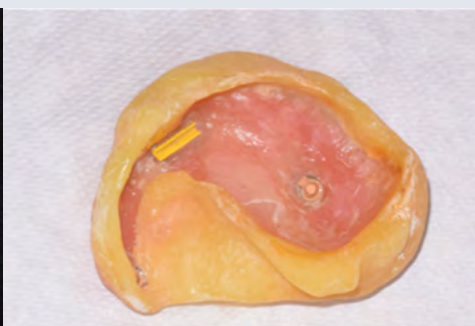


Figure 3a. Implant bar-retained interim obturator #2 relined with Rimseal-Intaglio Surface.



Figure 3b. Implant bar-retained interim obturator #2 relined with Rimseal-Intramural. Frontal view.



Figure 3c. First implant bar.



Figure 4. Master cast.

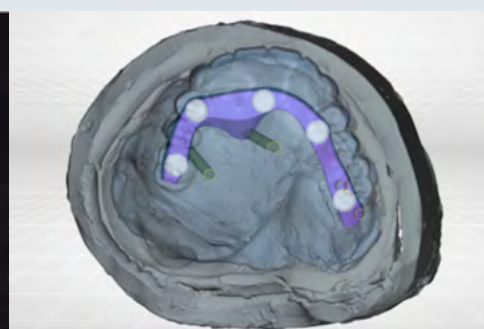


Figure 5a. Digital rendering of bar with superimposed diagnostic wax up. Occlusal view.

(Figure 2). A fixture-level impression was made in the operating room for fabrication of an interim milled implant bar to splint the zygomatic and dentoalveolar implants during healing. To expedite fabrication of the bar, no diagnostic set up or prosthetic wax try-in was performed, thus creating an arbitrary bar according to anatomic structures.

The patient returned to the clinic for insertion of an interim milled implant bar (*Cobalt Chrome Implant Bar, Panthera Dental*) and fabrication of a new interim obturator, which was implant-supported, and hader clip (*Hader Clip, Sterngold Dental*) and ERA (*ERA, Sterngold*) attachment-retained. The prosthesis was relined chairside (*Bosworth Rimseal, Keystone Dental*) to ensure complete seal of the defect (Figures 3a,b,c). The interim milled implant bar provided much needed retention for the interim obturator prosthesis and also served to splint the zygomatic implants during osseointegration.

After four months of healing, a milled implant bar was fabricated for support and retention of the definitive obturator. To avoid a complicated intraoral fixture-level impression that was difficult due to trismus, the existing bar and obturator were used to fabricate a master cast. The cast was made using fast-set Type IV stone (*Snap Stone, Whip Mix Corp.*) with implant analogs attached to the existing implant bar

(Figure 4). The bar was placed within the current obturator, which was molded to perfectly obturate the defect. Soft-tissue borders were captured using polyvinylsiloxane (*Reprosil Quixx Putty, Dentsply Sirona*), which allowed resiliency to avoid damage to the prosthesis upon removal from the cast. Using this cast, a denture tooth set-up was completed and tried in. Once approved by the patient, the cast and denture set-up were sent for milled bar fabrication (*Cobalt Chrome Implant Bar, Panthera Dental*). Digital design of the bar with scanned overlay of the tooth set-up allowed for fabrication of the bar within the confines of the ideal prosthetic arrangement (Figures 5a,b). Once the design was approved, the bar was milled out of cobalt chromium with stud attachments.

The denture tooth wax-up was transferred to the new bar. The patient returned for implant bar try-in with final wax try-in. The definitive obturator was processed using heat-cured acrylic (*Lucitone 199, Dentsply Sirona*). The definitive implant bar with five locator attachments (*Zest Dental Solutions, Carlsbad, CA*) had a passive fit and was torqued to the appropriate manufacturer recommendation (Figures 6a, b, 7). Obturator was inserted and adjusted to avoid any hyperpressurization in the defect while maintaining adequate seal. At the time of insertion, no additional relines

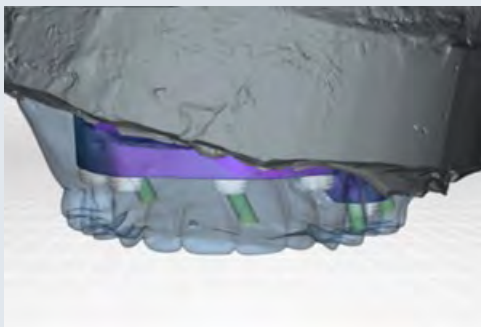


Figure 5b. Digital rendering of bar with superimposed diagnostic wax up. Frontal view.



Figure 6a. Definitive implant bar. Occlusal view.



Figure 6b. Definitive implant bar. Frontal view.



Figure 7. Panoramic radiograph of definitive implant bar.



Figure 8. Definitive obturator. Intraoral frontal view.



Figure 9a. Definitive obturator. Intaglio surface.

was needed (Figures 8, 9a-c). The patient was successfully prosthetically obturated with no evidence of nasal regurgitation or hypernasal speech (Figure 10). Strict hygiene was reviewed with the patient due to the hyperplastic inflamed mucosa that was noted around the zygomatic implants at one-week follow-up (Figure 11). The patient reports to the Maxillofacial Prosthetics Department for prosthetic follow-up, as well as the Head and Neck Department for oncologic surveillance. He has had no new primary cancers or recurrences and is on a three-month recall.

Discussion

Distant vascularized osteocutaneous free flaps (DVOFF) are an ideal choice for a maxillary defect that extends to midline or farther because of their ability to transfer an osseous structure for endosseous implant placement for prosthetic rehabilitation.^[4] Although free-flap success rates are in excess of 95%, recipient failures are noted and are predominately due to either primary thrombotic occlusion at the anastomosis or to secondary nonanastomotic deposition within the flap.^[14,15] In the case of the patient reported here, there was a recipient site complication that led to flap failure, leaving a large defect to be obturated.



Figure 9b. Definitive obturator. Occlusal surface.



Figure 9c. Definitive obturator. Frontal view.



Figure 10. Patient smile.



Figure 11. Zygomatic implant peri-mucositis.

Due to the size of the defect and the amount of maxillary bone that was removed, remote anchorage into the zygoma was explored. Introduced by Branemark in 1998,^[16] zygomatic implants are endosseous implants, typically 30 mm to 55 mm in length, that are placed into the zygoma in cases of atrophic maxillae or extensive surgical resections. The advantage of these implants over flap reconstruction is that the defect remains open for surveillance of recurrent disease.^[17] When a zygomatic implant is placed on the side of the maxillectomy defect, the patient typically does not have supporting osseous structures beyond that of the zygoma, leading to a long lever arm. As Schweitzer et al., explained, zygomatic implants are placed at a 30- to 65-degree angle relative to occlusal force and may be up to 50 mm in length, embedding only 10 mm to 15 mm into the zygoma.^[18] Although placement of zygomatic implants has been shown to be beneficial, with only one or two implants on a defect side,^[19,20] it has been strongly recommended to provide rigid, cross-arch splinting with an implant bar.^[17,18,21,22] Effective axial load to the implant is achieved by cross-arch stabilization.^[23]

The first bar was fabricated with hader clips (*Hader Clips—Yellow Regular Retention Insert, Preci-Horix, Alphadent NV, Belgium*) and

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ERA attachments (*Sterngold, Attleboro, MA*) to maximize the restorative space available for placement of an immediate implant-retained obturator. Once the patient was well healed, and time allowed for additional prosthetic try-ins, the definitive bar was designed virtually within the parameters of the prosthetic arrangement, with locator abutments as retentive features. The benefits of locator abutments include ease of replacement for the retentive inserts and familiarity among providers, as the attachment has become very popular in dental practice. In the definitive bar, the patient was provided with five locator (*Zest Dental Solutions, Carlsbad, CA*) abutments. Given the parallel nature of the abutments, all five abutments are not needed due to extreme retention. Different combinations were experimented with to allow for adequate retention, while still maintaining the ability for patient removal.

Conclusion

This case report demonstrates the successful prosthetic rehabilitation of a patient with an unfortunate surgical complication. Reconstruction with a fibula free flap is the recommended treatment for patients with large maxillectomy defects, as it provides adequate bone for placement and utilization of osseointegrated implants for prosthetic rehabilitation. However, in cases of flap failure, zygomatic implants are an alternative means to functionally rehabilitate the patient with an obturator prosthesis. This patient will require close, long-term follow-up for prosthetic maintenance and tissue surveillance. //

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