# Maxillofacial Prosthetics

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**KEYWORDS**

• Maxillofacial prosthetics • Maxillofacial prosthodontics • Obturator prosthesis
• Head and neck neoplasms—rehabilitation • Facial prosthesis

**KEY POINTS**

- Maxillofacial prosthetics is a branch of prosthodontics associated with restoration and/or replacement of stomatognathic and craniofacial structure with prostheses, which may or may not be removed on a regular or elective basis.
- After cancer ablation surgery in the head and neck region, a maxillofacial prosthesis can rehabilitate a patient's appearance and functions, including mastication, swallowing, and speech.
- When surgical construction after cancer ablation surgery is limited, patient functioning and esthetics can be restored by a maxillofacial prosthesis. Patient quality of life and psychological status are improved.
- A maxillofacial prosthodontist works closely with the oncologic surgeon, physicians, and others cancer care team members to deliver the best treatment outcome for the patient.

## INTRODUCTION

Maxillofacial prosthetics is a branch of prosthodontics associated with restoration and/or replacement of stomatognathic and craniofacial structures with prostheses, which may or may not be removed on a regular or elective basis.[1] After cancer ablation surgery in the head and neck region, a maxillofacial prosthesis can rehabilitate a patient's appearance and functioning, including mastication, swallowing, and speech. Not just after surgical treatment, but on many other occasions the maxillofacial prosthodontist is requested to fabricate a device to support the ongoing cancer treatment. A positioned radiation stent for radiation therapy and a feeding appliance are good examples of those devices. In general, a maxillofacial prosthodontist works closely with the oncologic surgeon, physicians, and others cancer care team members to deliver the best treatment outcome for the patient.

## PROSTHETICS MANAGEMENT OF PATIENT AFTER MAXILLARY RESECTION SURGERY

Surgical excision of tumors in the maxilla is a principle reason for a maxillectomy or a maxillary resection surgery.[2,3] Even though it depends on the type and location of the tumor, cancer ablation surgery of the maxilla often involves hard palate, maxillary sinus, and nasal cavity. An alteration of the hard palate as the result of surgery can create a communication between the oral cavity and the nasal cavity. Because of this oronasal communication, a food bolus and liquids can escape the oral cavity to exit the nares. The failure to impound the air causes a sound distortion called hypernasality. The consequences of a maxillary defect can lead to unintelligible speech and difficulty eating with a potential for inadequate nutrition intake. Prosthetic intervention, with a maxillary obturator prosthesis, is necessary to restore the contour of the hard palate and to recreate the functional separation of the oral cavity and nasal

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cavity and maxillary sinus.[4] This prosthetic intervention can be started as early as at the time of the maxillary resection surgery and will be necessary for the remainder of the patient's life.

## PROSTHETIC TREATMENT PLANNING

Treatment planning of prosthodontic rehabilitation for the patient undergoing maxillary resection surgery starts before the surgery. The principle when treating maxillectomy patients preoperatively is a comprehensive evaluation, in a limited time, to maximize the health status after surgery and maintain the usefulness of the remaining teeth.[2,3] A comprehensive oral and dental examination should be performed and dental radiographs should be taken. An accurate study cast that includes all important anatomy has to be obtained (**Fig. 1**) and mounted in an appropriate articulator.[5] It is preferred to have at least 2 sets of casts. One is preserved as a pretreatment record and other may be used to fabricate the surgical obturator or interim obturator. Irreversible hydrocolloid is generally the material of choice for making the impression for study casts. This material has an innate property that captures anatomic details in a short clinical working time and is gentle to soft tissue, which is especially important around a tumor. When possible, dental prophylaxis or gross debridement should be performed as well as any minor operative dental procedures. These dental preventative measures minimize the risk of dental and periodontal problems owing to the difficulty of oral hygiene practice postoperatively. Unsalvageable teeth should also be removed at the time of surgery or preoperatively.

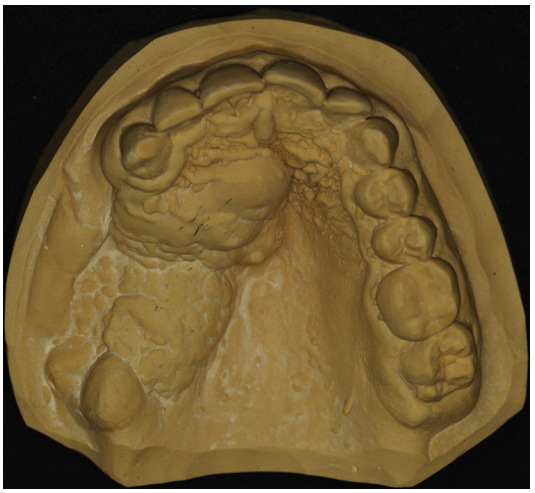

**Fig. 1.** Preoperative study cast for a maxilletomy patient.

It is very important to discuss with the patient the plan for oral rehabilitation. Most patients are not familiar with the services that the prosthodontist can provide. The benefits, limitations, and sequence of the prosthodontic treatment plan should be explained to the patients and their family. Patient compliance and acceptance are very important for the success of the treatment.

Prosthetics rehabilitation for maxillary resection surgery can be classified into 3 phases[4,5]:

- Surgical/immediate obturation,
- Postoperative/interim obturation, and
- Definitive obturation.

### *Surgical/Immediate Obturation*

Surgical obturation has many benefits for the either edentulous or dental patients who require any type of maxillectomy or palatalectomy. The benefits of surgical obturation include providing a matrix on which the surgical packing can be placed and a decrease in the risk of oral contamination to the wound. The prosthesis improves the patient's psychological status by enabling the patient to speak and swallow immediately after surgery. The ability to swallow immediately after surgery may eliminate the need for a nasogastric tube or facilitate earlier removal. When using a surgical obturator, the hospitalization period potentially reduces to 3 to 5 days after surgery.[5]

Communication between the prosthodontist and the surgeon is critical for the design and fabrication of the surgical obturator prosthesis. The goal of a head and neck surgeon is to achieve complete oncologic resection of the tumor and leave clear margins at the resected site. However, for prosthodontic rehabilitation after maxillary resection surgery, maintaining as many structures (eg, hard palate, teeth) as possible is the key to improving functional outcomes with a maxillary obturator. In general, the prognosis of the prosthodontic rehabilitation of edentulous patient varies with the defect size.[6] For the dentate patient, the more alveolar process and teeth that are preserved, the better the functional outcome of the prosthesis. The surgical incision line also greatly influences the design and extension of the surgical obturator. One should design an obturator with the most conservative line of resection. By using the most conservative surgical planning, the prosthesis may be used even if the defect is larger than previously planned. However, if the most extensive line of resection is used for design and less tissue is resected at the time of surgery, the surgical obturator could be too large and would require an adjustment in the operating room. In

some institutions, maxillofacial prosthodontists are part of the operative team and can make necessary intraoperative adjustments. However, prosthodontists are not always in the operating room and, thus, preoperative communication is critical between the head and neck ablative surgeon and the prosthodontist. This communication of surgical extent ensures appropriate sizing and fit of the temporary surgical obturator for the maximum postoperative benefit.

When considering the extent of surgical resection, the head and neck surgeon and prosthodontist should discuss performing maxillectomy through the socket of an extracted tooth rather than at the interproximal area.[6] An interproximal cut will result in resorption of the alveolar bone of the remaining teeth adjacent to the defect. This factor will eventually compromise periodontal health and vitality of the tooth next to the defect, which may likely lead to the loss of tooth. The tooth adjacent to the defect is an important abutment for the obturator prosthesis. If possible, the alveolar process that supports the tooth should be maintained.

There are several considerations for fabricating the surgical obturator. The surgical obturator should have a simple design, and be lightweight and inexpensive.[5] A clear heat processed acrylic resin or autopolymerizing acrylic resin is the material of choice for fabricating a surgical obturator.[4] The benefit of a clear acrylic resin is the ability to visualize the underlying tissue at the time of placement in the operating room and during the early healing period. For the edentulous patient, a peripheral extension should be made to the proper extension of a complete denture without overextension. Approximating the extension of the prosthesis into the soft palate and the pterygoid plate, especially in an edentulous patient, should be avoided. At the surgical defect or the skin graft–mucosa junction, the extension of the prosthesis should be terminated slightly short. The surgical packing will close any discrepancies between the surgical defect margin and the margin of the surgical obturator.[4]

The surgical obturator prosthesis for a dentate patient should be perforated at the interproximal area to allow the prosthesis to be secured with wire to the teeth at the time of surgery (**Fig. 2**). Securing the surgical obturator prosthesis for the edentulous patient is more challenging. It requires the use of a palatal bone screw. A titanium or stainless steel bone screw can be placed through the predrilled holes of the prosthesis at the anterior peak of palatal vault into the vomer. If the vomer is resected, 2 screws can be placed through the prosthesis into the lateral hard palate at the conflicting angle.[4]

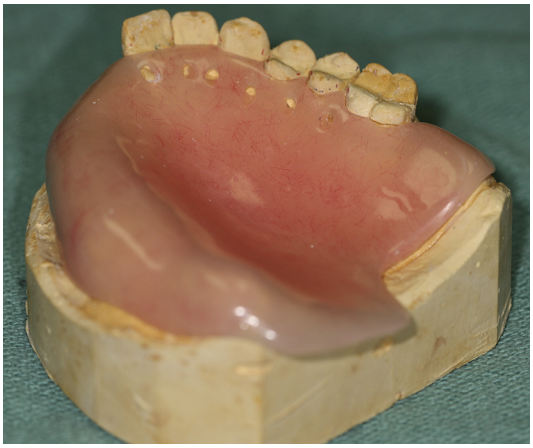

**Fig. 2.** Processed surgical obturator with perforated holes ready for the surgery.

In general, the original palatal contour should be reproduced. Anterior teeth can be included in the surgical obturator for psychological and speech reasons. However, posterior occlusion should be avoided to minimize the risk of trauma to the surgical defect area.

### *Postoperative/Interim Obturation*

After the initial healing period, approximately 7 to 10 days postoperatively, the surgical obturator prosthesis and surgical packing are removed. A definitive prosthesis is not indicated until the surgical site is healed and dimensionally stable.[5] The complete healing time for the surgical site may be up to 3 to 4 months or more if radiation is included in the regimen. In this period, the interim obturator prosthesis is needed to restore function, such as speech and swallowing, as well as esthetics for the patient. The interim obturator also helps to improve the patient's psychological and emotional status.

For the completely edentulous patient, the prosthesis base used for surgical obturator can be modified to serve as an interim obturator prosthesis. The base plate is border molded and relined using soft liner material (prosthesis polyethyl methacrylates acrylic resins; **Fig. 3**). The viscosity of the material can be altered by changing ratio of powder (polymer) and liquid (monomer). This material also has great handling properties and can be shaped manually.[4] The residual hard palate area and border area should be relined first for optimum stability of the base plate. The defect area can be impressed starting from the bony tissue border. The periphery of the of the defect is impressed by manually and arbitrary extending the soft liner material and then adding the material incrementally. During impression of the defect site, the patient

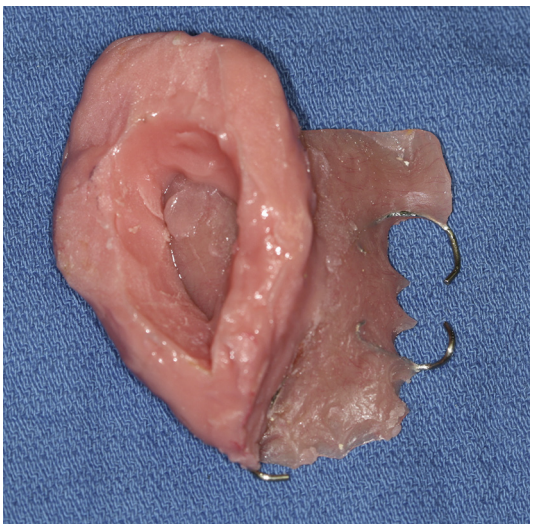

**Fig. 3.** Interim obturator.

should be directed to perform exaggerated head movements and swallowing motions. This technique is an attempt to simulate a functional movement and should be performed with any addition of incremental of soft liner material. After this functional impression, the base plate with impression material is flasked and processed with autopolymerizing or heat polymerizing acrylic resin and delivered to the patient within a few hours.

The simple ways to evaluate the performance of the obturator are by speech and swallowing.[7] The only speech sounds in English that are formed when air passes through the nasal cavity are 'n', 'm', and 'ng'. Some authors have suggested to listen to patient recreate the 'm' sound and the 'b' sound.[4] If the 'b' is clear and distinct, then there is no air escaping beyond the obturator. The phenomenon of air escape from the oral cavity to the nasal cavity during speech is called hypernasal speech. Another method to evaluate the obturator prosthesis is by drinking water. With the prosthesis in place, the patient should be able to drink water without nasal leakage in an upright position.

The same general principles apply to the dentate patient. However, the interim prosthesis or prosthesis base should be fabricated from a duplication of the second set of casts. This acrylic resin base should incorporate retentive wires in strategic locations. Soft liner material can also be used to reline and make a functional impression of the defect site. Patients should be educated that, throughout the healing period, an interim prosthesis needs to be routinely revised to maintain the performance of prosthesis. Once the defect site is stable, the prosthetics rehabilitation process should continue to definitive obturation. If the opposing mandibular teeth are present, having a single posterior occlusal contact position increases the stability of the prosthesis. Home care instructions should also be given to the patient in this phase including dental hygiene, defect cleaning, and prosthesis care.

### *Definitive Obturation*

During the healing period, patients should see their prosthodontist every 2 to 3 weeks for any needed revisions of the interim prosthesis. By 3 to 4 months, most patients have adjusted mentally and have realized that their mastication and speech will not be substantially compromised. It may be several months after surgery before the surgical area is completely stable without tissue change. This may be up to 6 to 12 months after completion of therapy depending on the size of the defect site.[4,5] Also, healing time may be affected by the radiation treatment. In the late interim phase before the definitive obturation, any auxiliary treatments such as endodontic and periodontic work should be completed. Additionally, all the remaining teeth should be reevaluated. Preliminary impressions are made and study casts are properly mounted. The prosthodontics rehabilitation plan should be developed systematically and thoroughly owing to the multiple considerations, which differ from a routine prosthodontic patient. Movement of the prosthesis will be significant during functioning.

For the edentulous patient, without an osseointegrated dental implant, it is very difficult for a prosthesis to stay in place without using denture adhesive. Indeed, collaboration and involvement of an oral maxillofacial surgeon from the initial planning of the oral prosthesis is important. Placement of an osseointegrated dental implant can significantly improve the function of obturator prosthesis.[5] Suitable locations for osseointegrated dental implants include the anterior maxilla and the maxillary tuberosity.[5,8] The osseointegrated dental implant placement can be done at the time of surgery or at some appropriate time thereafter. Radiation is a critical factor that could compromise the short-term and long-term osseous integration and durability of dental implants in this patient population.[8,9] The patient's quality of life, prosthesis performance, risks, and benefits are factors to consider for using an osseointegrated dental implant to support and stabilize the obturator prosthesis. However, with or without an additional support from the dental implant, the principle is to preserve the hard palate, residual ridge, and healthy abutment teeth for the maximum support, stability, and retention of the prosthesis (**Fig. 4**).

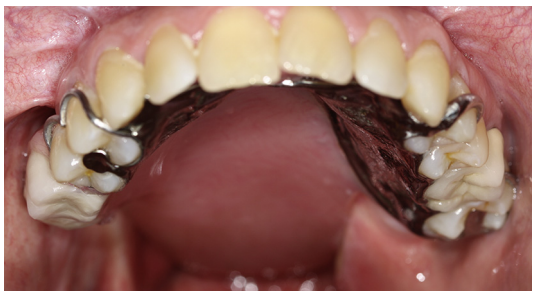

**Fig. 4.** Definitive obturator.

## COMBINED SURGICAL-PROSTHETIC REHABILITATION

Recent advances in computed tomography imaging and medical modeling have facilitated preplanning for complex surgical reconstruction of the mandible and the maxilla using vascularized free flaps. This advancement also facilitates prosthodontic rehabilitation of the oral cavity for both functional and cosmetic purposes. Indeed, implant supported prostheses can be used to effectively restore function and esthetics for the patient.[5,10] This planning is often most desirable in a younger patient population that is healthier, but it can be applied to wide range of patients. The patient selection for this combined surgical and prosthetic rehabilitation is very important. The defect site must be proven to be free of disease and sufficient (>2 cm) in size.[5] The common donor sites used for bone reconstruction are iliac crest, scapular, and especially fibula free flaps.[10] Careful prosthetic and surgical planning are required. Computer software using computed tomography data is used to create a 3-dimensional model with fabrication technology (eg, a stereolithography model). The oral maxillofacial surgeon, head and neck surgeon, and the prosthodontist can then collaborate over this model to identify ideal locations for the reconstruction, the osseointegrated dental implants, the titanium plate, and the subsequent prosthesis. Osseointegrated dental implants can be placed simultaneously in the free vascularized graft at the time of surgery (1-stage procedure). However, malangulation of the dental implants and compromise of flap vascularization are risks of a 1-stage approach. As a result of these risks, many institutions prefer a 2-stage surgical approach. This technique allows 6 to 12 months of healing and vascularization of the free fibular graft. Osseointegrated dental implants are then placed after radiation and healing is complete. Prosthetic rehabilitation will start 4 to 6 months later for an adequate time of healing and osseointegration of the dental implant.

Prosthetics reconstruction of the dentate patient with reasonable remaining teeth and hard palate can be achieved by a removable partial denture obturator prosthesis. Normal speech and swallowing can be restored as well as reasonable mastication. Creating a favorable defect (eg, skin graft of the defect, conservative incision line to preserve healthy periodontal structures of key abutments) for the prosthesis is the key to success of the rehabilitation. This process requires good communication and collaboration with the oncologic surgeon and maxillofacial prosthodontist before the tumor ablation surgery. For the edentulous patient, speech and swallowing can be restored but mastication remains a challenge (**Fig. 5**). Using dental implants in the residual ridge significantly improves the performance of the prosthesis, especially during mastication.

Finally, home care and oral hygiene are very important to long-term success and satisfaction. Irrigation of the defect daily with normal saline is recommended. The removable prosthesis should not be kept outside of the mouth for an extended period of time. The prosthesis should also be in place after cleaning with each meal. Daily teeth and implant cleaning with proper modalities needs to be reinforced to the patient to maintain the health of the remaining oral tissue.

## PROSTHETIC MANAGEMENT OF THE SOFT PALATE DEFECT

The soft palate is a complex neuromuscular aponeurosis.[11] It consists of multiple muscles such as the tensor veli palateni, the palatoglossus, the palatopharyngeus, the levator veli palateni, and the musculus uvula muscles.[12] These muscles are innervated by the pharyngeal plexus (vagus nerve, cranial nerve X), except for the tensor veli palatine, which is innervated by mandibular division of trigeminal cranial nerve (cranial nerve V). The physiologic function in this

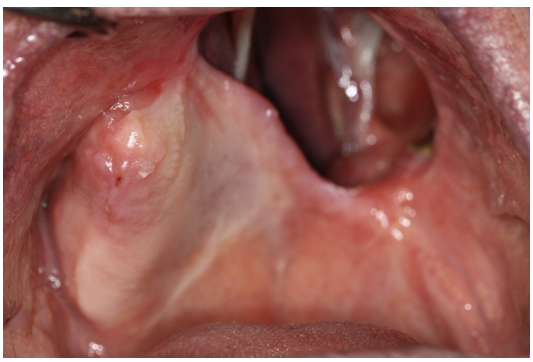

**Fig. 5.** Maxillary defect (edentulous).

region, also known as a velopharyngeal function, requires a simultaneous movement of the muscles in this area.[13,14] One or a combination of structural and motor limitations within the velopharyngeal mechanism can result in velopharyngeal dysfunction. This velopharyngeal dysfunction can result in hypernasality and poor intelligibility of speech.[13,15] In general, there are 2 terms that are used to describe velopharyngeal dysfunction based on physical and/or structural integrity. Palatopharyngeal/velopharyngeal insufficiency describes velopharyngeal dysfunction when there is a tissue or structural defect of the velum or pharyngeal wall resulting in unaccomplished closure at the level of the nasopharynx.[11,16] When the soft palate and the pharyngeal structures are of adequate dimension but fail to close the nasopharynx because of muscular and/or neurologic incapacity, the term palatopharyngeal/velopharyngeal incompetency applies.[11]

Surgical excision of neoplastic disease in the soft palate area can include the soft palate and adjacent structures.[13,17] The delicate functional balance between muscles and the velopharyngeal mechanism is often affected by surgery, but the degree of this dysfunction depends on the extent of surgical resection and method of surgical closure.[13] When the function of the palatopharyngeal area is altered owing to the insufficient structures after the tumor resection, an obturator prosthesis can be designed to close the opening between residual soft palate and the pharynx.[11] The goals of the pharyngeal obturator prosthesis, also known as speech bulb prosthesis or speech aid prosthesis, are to provide an adequate ability to control nasal emission during speech and to prevent the leakage of material into the nasal passage during swallowing.[5,14,18,19] Similar to a hard palate defect, prosthetic treatment for the acquired soft palate defect patient can be approached as immediate/surgical obturation, interim/delayed obturation, and definitive obturation (Fig. 6).

### *Surgical/Immediate Obturation*

The immediate/surgical obturation is most useful in the dentate or partially edentulous patient.[14,18,19] In the edentulous patient or the patient with limited medial or lateral posterior border resection, a delayed obturation approach is preferred.[19] The immediate obturator prosthesis will additionally provide support and retention of the surgical packing. The greatest challenge in the fabrication of an immediate soft palate obturator prosthesis is a proper soft palate extension. For example, the drape of the intact soft palate precludes the clinician from obtaining an impression of the nasopharynx in which normal palatopharyngeal closure occurs[5,19] Also, it is very difficult to delineate the surgical margins before the operation. Adjustments at surgery are generally required for the proper extension without excessive tissue contact as well as providing space for a nasogastric tube.

### *Postoperative/Interim Obturation*

At 7 to 10 days after the surgery, the prosthesis and surgical pack are removed. The tissue contact, especially at the lateral and posterior border, are checked. Then the soft liner material is used to correct the palatopharyngeal extension area of the prosthesis. The patient is instructed to perform head movements and swallowing movements to mold the extension area to the proper dimension.[19] Speech and swallowing are evaluated. The patient is followed with sequential appointments until a definitive prosthesis can be fabricated.

### *Definitive Obturation*

Construction of soft palate defect definitive prosthesis usually starts with a conventional removable prosthesis. Then the palatopharyngeal area is extended to the defect area.[5,18,19] The prosthesis should be designed carefully to accommodate the extra weight and movement of the defect area to provide adequate support, retention, and

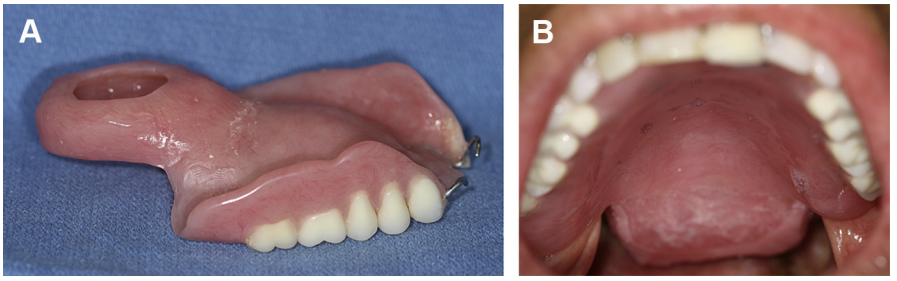


**Fig. 6.** (*A*) Interim obturator for oropharyngeal defect. The posterior part of the prosthesis was hollowed to decrease its weight. (*B*) Interim obturator for oropharyngeal defect in the patient's mouth.

stability of the prosthesis. The success of the definitive soft palate prosthesis depends on the patient's ability to move the residual muscles of the pharyngeal complex during speech or swallowing. The chance of achieving normal speech is low if the patient exhibits little or no movement of the residual palatopharyngeal complex and they will have hypernasal speech owing to an inability to control nasal emission.[19] In the past for an edentulous patient, the meatus design obturator has historically been recommended.[18,20] The meatus obturator was introduced based on the belief that muscle training in the soft palate area is difficult and may not be success for some patient. Unlike a regular fixed type obturator, this type of obturator ignores the Passavant's pad and the ability of the posterior pharyngeal wall to move. The posterior portion of the meatus obturator extends perpendicular to the hard palate and occludes the airway posterior to the nasal cavity. However, this type of obturator requires extensive clinical experience for their complex clinical procedures.

## PROSTHETICS REHABILITATION OF THE ACQUIRED MANDIBULAR DEFECT

Prosthetics rehabilitation of the acquired mandibular defect resulting from oral cancer is very challenging. It requires a good understanding of anatomy and mandibular movement. The extent and location of the mandibular defect, especially the presence or lack of mandibular continuity, are important factors for a favorable outcome.[18,21,22]

### *Conventional Prosthesis*

#### *Continuity defect*

Resection of the mandibular body with overlying tissue while maintaining the inferior border of the mandible and its continuity is called marginal mandibulectomy.[22,23] This surgical technique is indicated for head and neck cancer treatment, including cancer of the lower lip, the floor of the mouth, retromolar trigone, gingiva, buccal mucosa, and some skin cancers in the facial area.[23] Soft tissues are used to reconstruct the marginal mandibulectomy such as a skin graft, pedicle graft, or microvascular graft depending on the extension of the resection. Prosthetic rehabilitation after marginal mandibulectomy is less complicated because the continuity of the mandible is maintained and the muscles of mastication are frequently intact.[5,21,22] Conventional removable partial denture type prostheses can enhance a patient's esthetics, improve speech, and provide effective mastication.[21,24]

Owing to the supporting area being compromised, the basic objectives of removable partial denture design is to control and minimize movement of the prosthesis. This minimizes trauma to the reconstructed defect site. The removable partial denture also should have a maximum extension of the denture base and stable occlusion of the prosthesis.[18]

#### *Discontinuity Defects*

The prognosis for prosthetic rehabilitation for the patient with a mandibular defect is quite variable. For many patients, reasonable mastication can be achieved, although in some patients only esthetics can be improved.[21] Mandibles lacking continuity are severely compromised biomechanically.[24] All jaw movements and positioning, including resting position, opening, closing, and protruding, are functioning with the remaining muscles around a single load-bearing joint. There are other multiple factors that affect the movement of the discontinuous mandible, for example, the locations of the defect, the number of the remaining teeth, wound healing, and radiation scarring on the defect side.[18,21,25] These factors result in a deviated jaw, a closing movement toward the defect side, and an occlusal discrepancy in the dentate patient.[18,21,25] A specially design removable prosthesis can be fabricated to manage these adverse

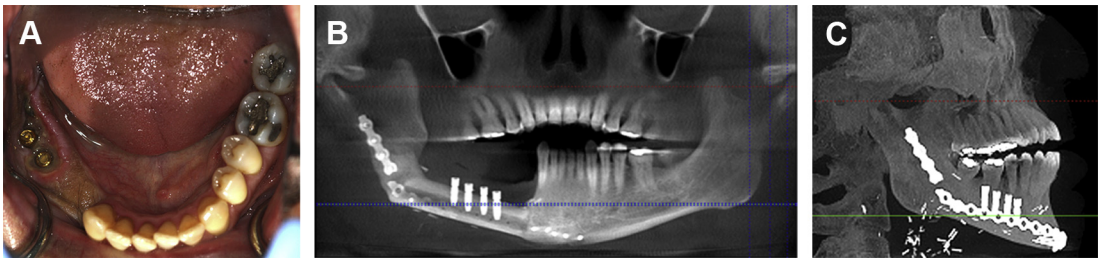


**Fig. 7.** (*A*) Mandibular defect reconstructed with fibular reconstruction. Intraoral view. Owing to the soft tissue approximation at the surgery, 2 dental implants were used to support the prosthesis. (*B*). Cone beam computed tomography panoramic view. (*C*) Cone beam computed tomography lateral view.

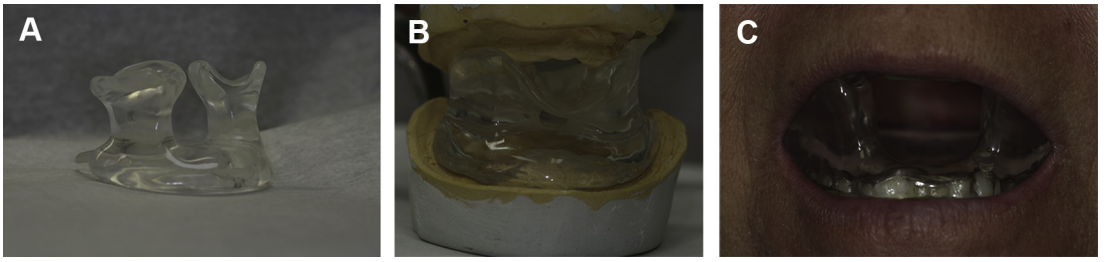


**Fig. 8.** (*A*) Radiation stent (tongue depression stent). (*B*). Radiation stent in the working cast. (*C*) Radiation stent in the patient's mouth.

outcomes after mandible and tongue surgery and improve function and esthetics for the patient.

## COMBINED SURGICAL-PROSTHETIC REHABILITATION

Like the maxillary defect, after cancer resection surgery, an osseocutaneous free flap can be used to reconstruct the mandible.[25] There are multiple available donor sites for free flap reconstruction of the mandible including an osseocutaneous radial forearm free flap, scapula free flap, iliac crest free flap, and the fibula free flap.[26] The fibula free flap provides the greatest bone length, the optimal dimension for a dental implant, and minimal donor site mobility.[26,27] Two surgical teams can work simultaneously at the donor site and recipient site, decreasing the overall operative time. Occasionally, osseointegrated dental implants can also be placed in the same surgery (Fig. 7). However, as discussed, the 2-stage approach for dental implant placement is preferred in many institutions. The 2-stage approach minimizes the risk of complications including compromise of the free flap's blood supply. Another advantage of the delayed implant placement approach is to allow the oral and maxillofacial surgeon to place the dental implant in the ideal position and angulation for supporting the mandibular resected prosthesis.

### *Ancillary Prosthesis for Cancer Therapy*

#### *Positioning stents during radiation therapy*

Maxillofacial prosthodontists often are asked to fabricate a prosthetic device to support radiation therapy cancer treatment. The design of the device depends on the modality of radiation therapy for the patient with head and neck cancer. In the past, a prosthetic device was necessary to position the radioactive isotopes for brachytherapy.[28] However, as brachytherapy has becoming increasingly rare, the use of these devices has also diminished. External beam radiation with an intensity-modulated radiation therapy technique has become the treatment of choice for radiation delivery in the head and neck.[28,29] Organ immobilization and the ability to allow repeatable positioning of the patient on daily basis throughout 6 to 8 weeks of radiation therapy are critical for excellent treatment outcome of intensity-modulated radiation therapy (Fig. 8).[28,29] Recently, intensity-modulated proton therapy has also been used to treat patients with head and neck cancer.[30] Similar to intensity-modulated radiation therapy, intensity-modulated proton therapy provides a more precise radiation delivery dosage. Positioning stents are often required for this radiation treatment as well. Depending on the location of the tumor and type of radiation therapy, the maxillofacial prosthodontist can design the positioning stent to serve the needs of the radiation oncologist.

#### *Fluoride carrier tray*

One of the most common complications during and after radiation therapy for patients with head and neck cancer is salivary gland dysfunction.[31–33] The ionizing radiation causes irreversible damage to the cells of the salivary glands, leaving the

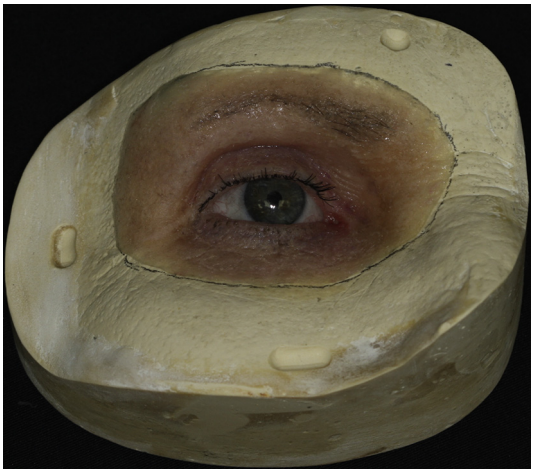

**Fig. 9.** Orbital prosthesis.

**Fig. 10.** Ocular prosthesis.

remaining saliva thick and sticky. Patients with salivary gland hypofunction and salivary dysfunction usually have xerostomia, which generally associates with dental caries.[34] This type of dental caries is so-called radiation caries. To prevent radiation caries, a dentate patient who is undergoing and has completed head and neck radiation therapy, topical fluoride treatment is necessary.[31,32,34,35] The patient is counseled to use a high concentration neutral fluoride with a custom mouthpiece application during radiation therapy and to continue this life-long daily topical fluoride treatment after radiation therapy.[31,32,34–37]

### *Facial Prostheses*

As a result of head and neck cancer surgical treatment, some patients require treatment with a facial prosthesis.[38,39] When surgical reconstruction alone cannot fulfill the patient's needs, a facial prosthesis is used to obtain reasonable esthetics of the patient and may also improve function. A facial prosthesis is an artificial replacement of an eye, ear, nose, or other portion of the face that restores normal appearance may improve function (**Figs. 9–12**).[1] The prosthesis is made of medical grade silicone rubber and is custom made to suit the fit and appearance of the individual patient.[33,40] Osseointegrated implants can be placed in strategic maxillofacial areas, which can improve retention and acceptance of facial prostheses.[41]

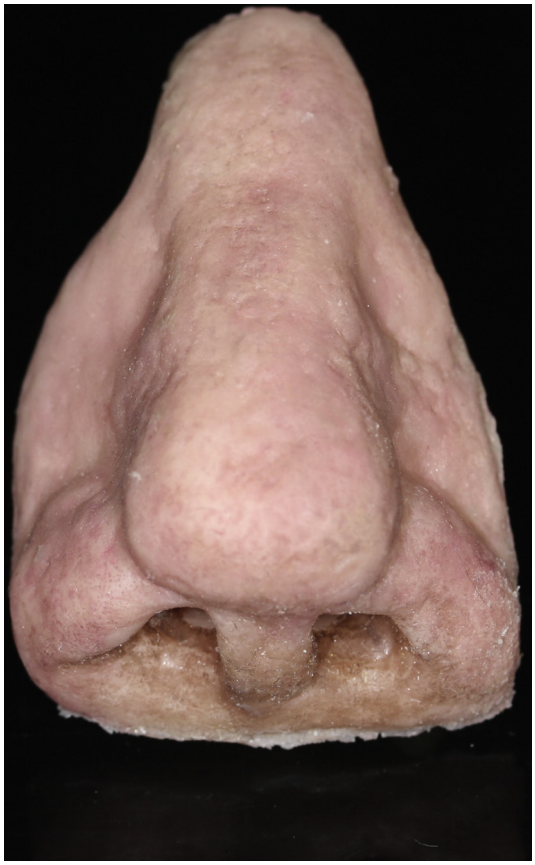

**Fig. 11.** Nasal prosthesis.

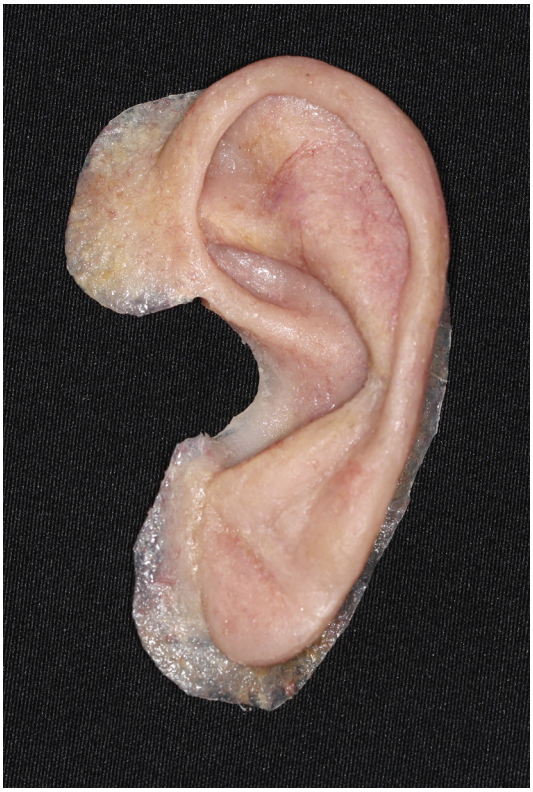

**Fig. 12.** Auricular prosthesis.

## SUMMARY

The treatment of patients with head and neck cancer requires a team approach. Maxillofacial prosthetics are used to support the cancer treatment team during treatment, with oral rehabilitation, and also to improve the patient's quality of life after cancer treatment.

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