Palatomaxillary Obturation and Facial Prosthetics in Head and Neck Reconstruction

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Defects of the head and neck are unique challenges to both reconstructive surgeons and prosthodontists. Surgical reconstruction and prosthetic restoration are two treatment options that are not always exclusive for a particular defect. The decision to pursue one or the other is dependent on a variety of factors. Surgical reconstruction is limited by the quality of donor tissue, including texture, color, and viability, although these limitations have been reduced given the advent of free tissue transfer. Prosthetic limitations include limited space for the prosthesis as well as mobility of adjacent areas, leading to poor retention. Patient comorbidity and preferences also play a role in deciding the optimal rehabilitation option.

Large midfacial defects are considered some of the most challenging problems for the reconstructive surgeon. Owing to the complex nature of nearby structures, including the nose, orbit, and maxilla, an aesthetically pleasing surgical reconstruction is often impossible even with bone grafting and free tissue transfer. Etiologies for these defects are generally secondary to surgical resection of large, neglected malignant tumors of the maxilla and face; however, infections such as invasive fungal sinusitis and ballistic trauma injuries can also result in similar tissue loss. Extensive face defects not only impair patients functionally, in terms of speech, mastication, and swallow, but also limit a patient’s ability to interact in the society, leading to social isolation and clinical depression. Optimal rehabilitation includes restoration of both aesthetic form and function. Often, this requires free tissue transfer in conjunction with palatomaxillary obturators and facial prostheses.

Perioperative Considerations

Treatment of head and neck malignancies can result in devastating defects leading to poor functional and aesthetic outcomes. Patient expectations must be counseled extensively on postoperative expectations. Patient demographics, functional status, and preexisting medical comorbidities should be...
considered for optimal reconstruction. In many cases following microvascular free flap reconstruction, hospital course can be prolonged, with many needing revision surgeries. Additionally, prosthetics can generally recreate similar preoperative aesthetic outcomes that may not be possible with contemporary microvascular and reconstructive techniques when complex structures of the orbit and nose are involved. In elderly patients with significant other comorbidities facing large defects in the head and neck, prosthetic rehabilitation may be of significant benefit.1,2

Collaboration between the reconstructive surgeon, prosthodontist, and anaplastologist is essential for prompt, successful rehabilitation and integration of obturators to the patient’s native tissue. Sound oncologic resection margins should be obtained. While not always permissible, maximal amount of maxillary dentition and bone allows for structural integrity of planned postoperative obturators. Attention to maxillectomy cuts through the bone sockets avoids devitalization of adjacent teeth. The anterior alveolar ridge and laterally the maxillary tuberosity are essential for securing obturators postoperatively.3 Other structures such as the inferior aspect of the vomer and the inferior turbinate may hinder obturator engagement above the palatal shelf. Haug described the removal of the coronoid process in cases where laterally the maxillary tuberosity are essential for securing obturators postoperatively. Attention to maxillectomy cuts through the bone sockets avoids devitalization of adjacent teeth. The anterior alveolar ridge and laterally the maxillary tuberosity are essential for securing obturators postoperatively. Other structures such as the inferior aspect of the vomer and the inferior turbinate may hinder obturator engagement above the palatal shelf. Haug described the removal of the coronoid process in cases where.

Retention Systems

Patient compliance relies on the retention system utilized. Historically, facial prostheses were anchored to spectacles or mechanically anchored against the undercuts utilized in the early part of the 20th century (can consider adding a spectacle prosthetic picture).3 Technological advances in anchoring systems and medical adhesives have replaced these older retention systems. Major drawbacks of adhesives include the need for constant application, often every few hours due to perspiration and environmental humidity. Adhesives also tend to irritate the skin, can cause allergic reactions, and lead to imperfect positioning of the prosthesis.5–8 Anaplastologists who do use adhesives have generally refined the type of adhesive use to avoid getting irritation and allergic skin reactions.

Osseointegrated implants for facial prosthetic retention gained popularity in the 1950s following the discovery of bony compatibility with titanium. The introduction of bone-anchored retention systems has revolutionized craniofacial prosthetic rehabilitation by making prosthetics easier to wear, clean, and properly self-align. These are well-tolerated short surgeries with little long-term complication risk. Patient selection is paramount as adequate bone stock is necessary to allow implant integration. Irradiated patients tend to have higher risk of implant failure due to poor bone vascularity. There are many ways for osseointegrated implants to secure external prostheses, including bar-clip attachments, ball attachments, and magnets. Many craniofacial prostheses rely on magnet retention, given the added benefit of inconspicuous size and strong attractive forces. Due to less natural wear, bone-anchored prostheses tend to last between 3 to 5 years, about two times longer than adhesive prostheses.9–12

Palatomaxillary Obturation

Surgical Obturation

Obturation occurs through surgical, interim, and definitive stages. Surgical obturators are placed immediately after creation of a maxillectomy defect. This temporary obturator acts to separate the nasal and oral cavities. Benefits include allowance of speech and swallow immediately postoperatively. The obturator provides a neo-palate for the tongue to brace against with the initiation of swallow. Additionally, the obturator can provide some structural support to the soft tissue of the midface. The goals of surgical obturators include a lightweight construct to minimize discomfort, a simple easily modifiable construct to fit the surgical defect, and avoidance of posterior occlusion leading to pressure to adjacent tissues from surgical.13–15

The senior author (F.W.) demonstrates a case of prefabricated surgical obturator that can be augmented intraoperatively to better fit the surgical defect. This is a case of a prefabricated surgical obturator. The patient visited the prosthodontist preoperatively to make impressions, and the surgeon determined which teeth will be removed. The obturator was made prior to surgery. After resection, an obturator was placed to verify fit and occlusion and then it was removed. A denture reline material is used to line the obturator and the obturator is placed back in the mouth. The material sets in a few minutes to fill the defect, the obturator is removed, and excess is trimmed with a blade and finally replaced (Fig. 1A–F).

As an alternative to prefabricated obturators, the senior author (Y.D.) utilizes an Aquaplast surgical obturator after maxillectomy. Prior to oncologic resection, the obturator sheet can be trimmed to the size of the soft palate, heated with boiling water, and molded to the shape of the native palate. The shape is then set with rinsing with cold water. Following resection, the obturator can be secured with either rigidly with 2-mm lag screws or circumferentially to remaining soft tissue with permanent suture. Patients are then sent to the prosthodontist at 2 to 3 weeks for interim obturator formation.16

Interim Obturation

Following initial healing, the surgical obturator and packing are removed and the wound is debrided. The prosthodontist then relines the surgical obturator with softer material to approximate the defect better. This, in turn, improves patient comfort and promotes further healing of the maxillectomy defect. At this stage, the patient follows up with the prosthodontist two to four times during the first month. At each visit, the interim obturator is adjusted to the contour changes with wound healing. Regular visits may be extended up to 8 weeks after surgery until the wound contour stabilizes. During this time, patients are instructed on proper hygiene of obturators, including cleanses and irrigations. Obturator care is much like denture care and...
includes brushing with a nonabrasive cleaner or soap and water. Maxillectomy care includes saline irrigations through the nose and mouth.

**Definitive Obturation**

The definitive obturator becomes the finalized prosthesis for the patient following surgery. It can be started as early as

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**Fig. 1** (A) Upper maxilla benign lesion prior to resection. (B) Planned incisions of resection. (C) Resected maxilla lesion. (D) Prefabricated obturator. (E) A denture reline material to line the obturator. (F) Modified prefabricated obturator in place.

**Fig. 2** (A) Nasal and upper lip prosthesis. (B) Palatal obturator magnetically attached to nasal prosthesis. (C) Palatal obturator in place. (D) Palatal obturator and nasal prosthesis in place.
3 months following treatment, although some advocate further delay for patients undergoing adjuvant radiation. Focus of successful obturation should be on stability, which will need to incorporate as many undercuts of the maxillary defect as possible. An impression is obtained of the surgical site and then dental modeling material is placed over the framework to allow conformation to the defect. Casts are then fabricated out of impressions. The prosthetic bulb can be hollowed out for lighter prosthetic weight. Readers may refer to a comprehensive guide on prosthetic stability and framework design by Aramany and Parr et al.\textsuperscript{13,14} Additionally, the intraoral obturator can be the basis for attachment of facial prostheses should there be a combined facial and maxillary defect allowing for enhanced retention of both intraoral and extraoral prostheses.\textsuperscript{17,18} Fig. 2A–D shows a patient with a partial rhinectomy and palatal defect rehabilitated with a magnet retention combination nasal prosthesis and palatal obturator.

**Facial Prosthetic Materials**

Historically, various materials have been utilized in prosthetic reconstruction including, leather, porcelain, silver, papier-mache, gelatin, latex, and acrylic.\textsuperscript{9,19,20} Each of these has its own limitations as our understanding of the ideal prosthesis has evolved. The perfect material should be durable, flexible, lightweight, biocompatible, and hygienic. As such, modern prosthetics in head and neck reconstruction rely on various polymers including methacrylates, polyurethane, and silicone. These materials, particularly silicone, are clinically inert and allow for soft, flexible texture that provided excellent color and texture match to the surrounding facial tissue for the most

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**Fig. 3** (A) Patient with total rhinectomy defect. (B) Forehead scars limiting optimal nasal reconstruction options. (C) Nasal prosthesis (internal view). (D) Nasal prosthesis (external view). (E) Frontal close view with prosthesis. (F) Oblique view with prosthesis.
Nasal Prostheses

Partial or total rhinectomy defects are often extremely challenging surgical reconstruction cases. Nasal reconstruction requires addressing the layers of the nose including the internal lining, cartilaginous and bony support, and the skin envelope. Menick reports significant advances and technical modifications to the paramedian forehead flap and the workhorse flap for nasal reconstruction due to cosmetically similar color match and texture. Limitations of surgical reconstruction include poor wound healing secondary to adjuvant radiation, flap failure, and lack of appropriate donor tissue for optimal reconstruction. In such cases, prosthetics offer the best aesthetic result.

As discussed previously, retention mechanisms must be sufficient for placement of the prosthesis. Osseointegrated implants have significantly improved retention as facial mobility as well as air exchange humidification limited prior reliance on adhesives. Traditionally, these have been anchored to the glabella or the nasal floor. One study assessed zygomatic osseointegration for nasal prostheses and found that the zygoma provides better bone quality and stock for implants, as often this is outside of the adjuvant radiation field. Should inadequate bone be available for implantation, bony reconstruction of the maxillary can be considered using bony free tissue transfer. Specific soft tissue details for nasal prosthesis fabrication include limiting disruption of the melolabial crease to allow smooth transition of the prosthesis to the native facial tissue. Fig. 3A–F shows a patient with a total rhinectomy defect who underwent prior paramedian forehead flap reconstruction limiting optimal reconstructive options. A nasal prosthesis was fabricated with excellent aesthetic restoration.

Orbital Prostheses

Advanced sinonasal or cutaneous malignancies may require orbital exenteration, evisceration, or enucleation for definitive clearance of disease. These radical procedures leave patients with significant deformity. In cases of evisceration, where only the globe is removed with the Tenon’s capsule and extraocular muscles intact, orbital rehabilitation is typically performed using a prosthetic eye, which, if properly placed, will look and move in a fashion similar to the unaffected eye. In enucleation, the extraocular muscles must be reattached to the orbital implant. Following orbital exenteration, the orbital cavity is typically reconstructed with either regional muscle flap or free tissue transfer and

Fig. 4 (A) Healed right orbital exenteration defect. (B) Magnetic osseointegrated implants placed along lateral orbital rim. (C) Artistic fabrication of orbital prosthesis. (D) Orbital prosthesis in place.
skin grafting for anterior skull base coverage. Orbital prostheses then cover the entire orbital cavity, and impressions are generally made from the contralateral eye and painted to optimize color match. In patients with poor bone stock along the orbital cavity, adhesives may be used for retention, but as discussed previously, magnetic retention has been most successful (see Fig. 4A–D for patient example).25–28

Auricular Prostheses

Extensive auricular defects are a result of various etiologies including trauma, congenital atresia, and malignancies. Identification of appropriate candidates for surgical reconstruction is key in optimizing outcomes. Often, this depends on patient preference, relative comorbidities, and surgeon experience. Lateral temporal bone defects following ablative tumor resection are harder to reconstruct, particularly after adjuvant radiation where adjacent tissue can be devascularized. Auricular reconstruction is often multistaged given the need for reconstruction of the underlying cartilaginous framework, oftentimes requiring tissue expansion for adequate coverage and revision surgery for poor cosmesis. Patient satisfaction can be variable due to inconsistent results. For the aforementioned reasons, alloplastic prostheses remain an excellent option at optimizing form.9,29

Osseointegrated implants in auricular prostheses were noted to be highly successful given the option of temporal bone anchoring. In general, the implants are placed 2 cm along the posterior one-third along where the antihelix would be.30,31 In patients with intact ear canals and hearing, auricular prosthesis can provide clinically relevant functional acoustic gain. In patients where the canal is obliterated with intact conductive hearing, auricular prostheses can be utilized in conjunction with bone-anchored hearing aids to rehabilitate hearing. One study reports that patients were generally satisfied with the aesthetics of auricular prostheses, but skin complications arising from abutment issues were a source of dissatisfaction.32

Conclusion

Defects of the head and neck involving the maxilla, orbit, nose, and ear are challenging endeavors for the reconstructive surgeon. Particularly for patients who have undergone radiation therapy and multiple surgeries where regional flap options are not available for the optimal cosmetic and functional result, facial prostheses and obturators are a valid alternative that can afford excellent cosmetic and functional results. This review highlights the contemporary techniques used at fashioning facial prostheses, the importance of retention systems, and workflow of fashioning palatal obturators used for head and neck rehabilitation.

Conflict of Interest
None declared.

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