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An Overview of Maxillofacial Rehabilitation for the General Dentist

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ABSTRACT

The rehabilitation of the maxillofacial patient is mostly carried out in a multi-specialty treatment environment, such as a comprehensive cancer center, where multiple specialists are available to treat the numerous concerns and complications that may occur. Many of these patients are seen by the maxillofacial prosthodontist at the same time as the other members of the team, and maxillofacial rehabilitation can be treatment planned and performed expediently. Some patients, however, are treated without rehabilitation in mind and go years without appropriate referrals. A knowledge of the multiple types of prostheses available will allow the general practitioner to decide if a patient will benefit from maxillofacial care and make the appropriate referrals.

Maxillofacial prosthetics is the subspecialty of prosthodontics that deals with the creation of prostheses or appliances for structures beyond the immediate dental and alveolar region.[1,2] Maxillofacial prosthetics programs are generally one-year fellowships for graduates of three-year prosthodontic residencies that allow the practitioner to concentrate on learning the added techniques utilized in intraoral and extraoral rehabilitation. Although the primary focus is rehabilitating the structures in the oral and maxillofacial region, the scope of the specialty extends to the replacement of vital structures of the head and neck region, as well as the creation of somatic prostheses to replace missing structures in other sites of the body, such as the breast or shoulder.[3]

Other common procedures include the creation of devices that are not rehabilitative but assist in the delivery of other medical and dental treatments. Some of these prostheses are used to protect healthy orofacial structures during radiation therapy.[4,5] Other devices include appliances that reposition oral structures for improved function or alleviation of trismus symptoms.[6]

Most hospitals that perform ablative cancer surgery or provide treatment for congenital craniofacial deformities will have an affiliated maxillofacial prosthodontist, and referral to a regional cancer center is the most expedient way to obtain treatment. An added benefit to treatment at an academic or hospital-based institution is that most maxillofacial prosthetic procedures can be covered under medical insurance if the defect results from medical or surgical intervention. In cases where referral to a comprehensive cancer center is not possible, a referral to a local prosthodontist is often the best option, as maxillofacial rehabilitation is part of all prosthodontic training programs.

Intraoral Maxillofacial Prostheses

Most intraoral prostheses are created to replace a missing structure of the maxillary or mandibular jaw. The most common max-

illary prosthesis is the obturator, which repairs a defect in the jaw and separates the nasal cavity or maxillary sinus from the oral structures. Loss of maxillary structure is often caused by ablative care for cancer patients but can also be caused by congenital defects like oral clefts or infections like syphilis.[7] Other possible causes for loss of maxillary structure are trauma or drug abuse. The use of an obturator allows the patient to eat and drink without regurgitation into the nose or sinus and improves the quality of the patient's speech while providing a support framework for the lips, cheeks and other structures.

Obturators may also be described by method of retention, whether created with a complete denture framework and supported by the remnant edentulous ridge, created with a partial denture framework and supported by remaining dentition as well as appropriate use of the residual ridge and other oral structures, or implant-retained. For many surgically created defects, the maxillary obturator is initially designed as an edentulous plate that can be ligated to the remnant teeth or ridge with wire or sutures. The obturator is created from presurgical models and a modification of an immediate denture technique is used.[8]

In edentulous cases, suturing to the adjacent tissues or use of bone fixation screws can help retain the obturator. These surgical obturators are placed after resection of the diseased tissue and the resultant defect can be filled in by surgical gauze or a tissue conditioner reline (Figures 1,2). This allows the patient to wake from surgery with an immediate replacement of the missing jawbone and improves speech, swallowing and cosmetics. The maxillofacial prosthodontist is an integral part of the surgical team and is closely involved with the patient's postsurgical healing.

After a week, the surgical obturator is replaced with an interim obturator, generally constructed from a duplicate of the presurgical models (Figures 3,4). This obturator is all-acrylic with wrought clasps and denture teeth, which allows the patient to remove the prosthesis as needed and also allows for adjustment and relines as the healing process occurs. After complete healing of the defect and other adjuvant medical or radiation therapy, treatment is complete, a definitive maxillary obturator can be created (Figures 5,6).

Obturators can also be classified by location or type of tissue involved, including hard- or soft-palate obturators, as well as combined obturators. Many soft-palate obturators are classified as speech aid prostheses, as the primary objective is to restore velopharyngeal defects that may not otherwise affect swallowing[9] (Figure 7). Other types of maxillary prostheses commonly encountered are the palatal lift appliance,[1] which supports a neurologically or physically incompetent palate, or a palatal augmentation appliance, which decreases the volume of the oral cavity to compensate for missing tissue volume of the tongue or neurologic insufficiencies. These are often called palatal drop or glossectomy prostheses.[11]

TYPES OF MAXILLOFACIAL PROSTHESIS

Intraoral Prostheses

1. Postsurgical
   a. Maxillary obturators
   b. Mandibular resection prostheses
   c. Palatal augmentation prostheses
   d. Palatal lift prostheses
2. Congenital
   a. Cleft palate obturators
   b. Speech aid appliances
   c. Mandibular defect prostheses
3. Traumatic
   a. Maxillary obturators
   b. Mandibular defect prostheses

Extraoral Prostheses

1. Postsurgical
   a. Auricular prostheses
   b. Nasal prostheses
   c. Ocular prostheses
   d. Orbital prostheses
   e. Mid-facial prostheses
   f. Breast and somato-prostheses
2. Congenital
   a. Auricular prostheses
   b. Ocular prostheses
3. Traumatic
   a. Ocular prostheses
   b. Auricular prostheses
   c. Nasal prostheses
   d. Digital prosthetics
   e. Cranial plate prostheses

Appliances

1. Radiation devices
   a. Radiation carriers
   b. Radiation shields
   c. Radiation positioners
2. Surgical appliances
   a. Surgical stents
   b. Surgical positioners
3. Jaw-repositioning devices
   a. Custom trismus appliances
   b. Mandibular repositioning devices

Figure 1. Immediate maxillary surgical obturator on prepared cast.

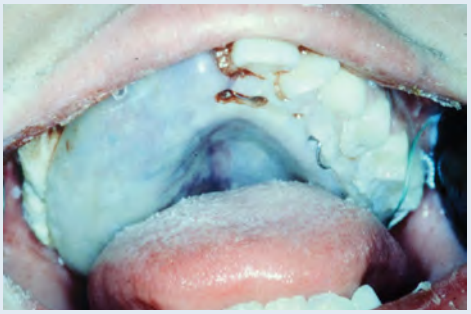

Figure 2. Surgical obturator ligated to residual dentition.

Figure 3. View of healing maxillary resection site.

Figure 4. Interim obturator in place.

Figure 5. Intaglio view of maxillary definitive obturator.

Figure 6. Maxillary definitive obturator in position.

In cases where reconstruction of the maxilla with osseous bone transfer and musculocutaneous flaps has been accomplished, implant-supported prostheses are also an option. Some of these are similar to the results attained by conventional implant dentistry; however, due to the volume of tissue lost, many of these will require an extensive superstructure and multiple sleeves and copings that resemble early high-water designs. In most cases with extensive removal of supporting tissue, esthetics and phonetics predicate the use of removable prostheses over fixed prostheses.

In the mandible, the most common type of prosthesis is the mandibulectomy or resection prosthesis.[12] Depending on the extent and location of the tissue volume lost, the prosthesis may closely resemble a conventional complete or partial denture with a severely limited basal seat and a shortened dental arch (Figure 8). The reduction of the arch length does not significantly affect the patient's function; however, the lack of retention, stability and support for the prosthesis is a major concern. The use of implants to retain a fixed or removable prosthesis often improves the patient's ability to function even with severely compromised arches. In some cases, the mandibulectomy prosthesis is not created for mastication but functions primarily to reposition the resected jaw fragment into an acceptable path of closure; and in lieu of teeth, a functional balancing ramp is used to allow the teeth on the non-affected side to achieve intercuspation (Figures 9,10). In cases where a mandible has been reconstructed with a graft, implant prostheses are a viable solution, and the use of fibular grafts as a site for the placement of dental implants has become commonplace[13] (Figure 11).

Another common internal prosthesis is the nasal septal prosthesis, often called a nasal button. Although this prosthesis is technically not an intraoral prosthesis, it works similarly to an intraoral obturator, as it closes an opening that develops in the septum of the nose that cannot be closed surgically. Most of these prostheses are custom made out of medical grade silicone in either a one-piece design that can be pulled into place from one nostril into the other or with mechanical or magnetic snaps that allow the fenestration to be closed from both sides of the septum.[14]

Figure 7. Speech aid prosthesis with soft palate bulb.

Figure 8. Mandibular resection prosthesis.

Figure 9. Balancing ramp in position on maxilla.

Figure 10. Residual mandibular fragment guided into appropriate intercuspation.

Figure 11. Implant-supported prosthesis for fibular graft.

Figure 12. Custom tracheostomy prosthesis in position.

Figure 13. Craniofacial implants in mastoid process.

Figure 14. Silicone auricular prosthesis with magnetic retention.

Figure 15. Midfacial defect requiring intraoral and extraoral prostheses.

A tracheostomy prosthesis is a similar type of prosthesis which replaces a stock tracheostomy tube with a custom appliance that blends into the surrounding tissue, or a pharyngeal obturator that seals an external opening in the throat. Most of these prostheses are made out of acrylic to enhance their durability and ease of cleaning; adhesive or tape may be used to retain them, although occasional use of local anatomy can be used to aid retention (Figure 12).

Extraoral Maxillofacial Prostheses

Although the success of a limited number of partial and full-face transplants has made international news in the past few years,[15] the use of prosthetic replacements for missing facial structures is still the primary method for treating large facial defects and missing structures. Certain structures like the eye are not replaceable with tissue transfer, and other structures like the ear and nose are complex surgical procedures requiring multiple operations in a highly specialized environment. In many cases, the results of these procedures are limited in function and esthetics.

Another reason to consider a prosthesis is the care of post-oncologic patients where the resection site has to be monitored over time for changes or where the amount of surgical or radiation-induced morbidity precludes the use of surgical reconstructive techniques. Maxillofacial prostheses that extend beyond the immediate maxillary region are called craniofacial prostheses and include eyes, ears and noses.

Smaller maxillofacial prostheses are often created out of medical-grade silicone, which can match the texture and coloration of a patient's natural skin tone, while larger prostheses are created from a combination of titanium or acrylic substructures veneered with silicone. In many cases, the use of implant retention can be utilized to help keep prostheses in position without the use of medical adhesives.

A common type of prosthesis is the ocular prosthesis, which replaces the eyeball contents when they are lost due to trauma or surgical enucleation. Most of these are custom made of acrylic using a painted iris disk and a custom impression to fill the contents of the socket to match the contents and profile of the opposing

Figure 16. Combination obturator and mid-facial prosthesis in place.

Figure 17. Chest wall defect after radical mastectomy.

Figure 18. Custom silicone breast prosthesis.

Figure 19. Cast of patient's eye prepared for radiation shielding.

Figure 20. Lead radiation shield encased in acrylic.

eye.[16] Remaining musculature or the use of an ocular implant that is engaged by the residual muscles allows for motility of the prosthesis, which further enhances the final cosmetic result.

An extension of the ocular prosthesis is an orbital prosthesis which replaces not only the eyeball but larger contents of the eye socket once an exenteration has been performed. A custom or stock ocular prosthesis is created and embedded in silicone, which is sculpted and stained to match not just the eye but the orbital contents and skin surrounding it as well. Orbital prostheses can be retained by adhesive, anatomical retention or with the aid of craniofacial implants integrated into the superior border of the orbit.

The replacement of the external ear is accomplished with a partial or complete auricular prosthesis. Oftentimes the replacement is due to a congenital defect where surgical reconstruction has not been possible, but it may also be due to trauma or for oncologic reasons. The bone-in-the-mastoid process is especially amenable to implant placement, and the long-term success of implant-retained auricular prostheses has been exceptional.[17] The retention of the prosthesis can be with a bar and clip system, which affords the highest level of security, or with individual magnets, which improve ease of placement in very young or elderly patients or those with limited dexterity (Figures 13,14).

The nasal prosthesis, which replaces missing structures of the nose, is one of the oldest facial prostheses reported as it is used to treat a common traumatic injury.[18] In many cases, this is primarily a cosmetic replacement, but in other cases, the development of proper nasal contours allows a patient to breathe and speak properly and prevents inflammation of surrounding tissues. Nasal prostheses are often created with anatomical retention, but they may also be designed for adhesive retention or implant retention from osseointegrated implants in the nasal floor.

An extension of the nasal prosthesis is the mid-facial prosthesis, which replaces contents of the lips and cheeks, as well as the nose, and may extend into the orbital region (Figures 15,16). Many of these prostheses are created in combination with maxillary obturators and may use the dental retention of the obturator as a support. In cases with limited access, the orbital or nasal portions of the prostheses can be connected with a magnet and allows the two pieces to separate for easy removal while engaging multiple undercuts to improve retention.

The last type of extraoral prostheses includes somatic prostheses, which are used to cosmetically reproduce missing parts of the body beyond the head and neck region. A common type of prosthesis is the custom breast (Figures 17,18) or nipple prosthesis created in silicone to replace surgically removed tissue.[19]

Appliances

Maxillofacial appliances are custom-made devices that are used to deliver treatment for other medical specialties or to protect tissues from unwanted radiation damage. These appliances include stents, shields, carriers and breathing appliances.[20]

Most maxillofacial stents are created as acrylic positioning devices to direct a beam or radiation in the most appropriate and repeatable position. Some of these appliances are also created to deliver or position radiation seeds for brachytherapy and are called radiation carriers. These appliances are generally prescribed by a radiation oncologist for appropriate use and are custom made by the maxillofacial prosthodontist for a facial moulage of the patient.

Maxillofacial shields are also created for radiation therapy patients; however, the purpose of these shields is primarily to reduce or eliminate the radiation dose around structures that do not need to be included in the irradiated bed. The use of lead or lead alloy shields encased in a plastic stent is an appropriate way to protect vital structures during radiation and can often be incorporated into a positioning device which combines both the advantages of a device to align a beam of radiation while protecting surrounding structures (Figures 19,20).

Breathing appliances are another variety of common maxillofacial device and often combine the use of interdental appliances that are retained by the dentition while incorporating a facial shield made out of acrylic or thermoplastic material to seal the airways around the mouth and nose.

Advances in Maxillofacial Prosthetics

Like most fields of dentistry, the use of digital imaging and fabrication has changed the way a maxillofacial prosthesis is created. The use of CBCT technology has improved outcomes in the placement of implants that can be used to retain intraoral prostheses,[21] and digital impression techniques have simplified capture of the residual tissues by direct or indirect capture methods.[22,23]

Other advances include the computerized scanning and milling of implant frameworks and the digital reproduction of resin patterns using CAD-CAM systems or 3D printing.[24] Other exciting advances include the use of photography techniques like Precision Image capture for implant positioning or photogrammetry[25] to rapidly simulate extraoral tissues and replicate them in a digital or physical format. Some maxillofacial prosthetics can be created directly in a rapid prototyping format. Others that require a level of craftsmanship that cannot be created digitally can be improved by digital milling or printing of the models or frameworks.

Conclusion

Since maxillofacial prostheses and appliances are not commonly seen in the general dental population, primary care dentists and physicians are often unaware of the variety and possibilities of these prostheses, and many patients go years without adequate treatment. An added impediment to the delivery of care is the large number of different medical and dental specialists who need to be available for associated treatments. Referrals to a local maxillofacial prosthodontist or a prosthodontist with maxillofacial experience, especially those affiliated with a dental educational institution or hospital, provide these patients with the best possibility of rehabilitation and a vastly improved quality of life.

Queries about this article can be sent to Dr. Frias at frias@maxillofacial.us.

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