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Review Article

Prosthodontist Contribution in Rehabilitation Post Maxillofacial Surgery: Review

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Abstract

Rehabilitation of post-surgical defects maxillofacial region requires a multidisciplinary approach. Maxillofacial prosthodontist plays an eminent role in restoring the normal health and function of the patient. This review highlights the role they plan in diagnosing, treatment planning along with conventional and advanced prosthetic management of such acquired defects.

Keywords: Rehabilitation, maxillofacial, prosthodontist.

INTRODUCTION

Despite the continuous advances in minimally invasive surgical techniques, most procedures to manage facial trauma, head and neck cancers still beset with undesirable sequelae which affect the quality of life in patients [1]. Rehabilitation of patients is quiet challenging and requires multidisciplinary team for comprehensive care and optimal post treatment functional outcomes. The team usually comprises of otorhinolaryngologist, radiation oncologist, medical oncologist, maxillofacial prosthodontist, speech therapist, psychologist, social workers, and nursing staff [2-4].

Most often advanced cancers or trauma involve the maxillofacial region and destroy the soft and hard tissues of jaws, facial skeleton, oral tissues, lips, checks, nose and eyes. The defect may result in oroantral, oronasal, oronasal-orbital communication. A maxillofacial prosthodontist plays a significant role in rehabilitating the post surgical defect and restoring function of speech, deglutition and contribute to improve their quality of life [5]. This review highlights the role of maxillfacial prosthodontist in diagnosis, treatment planning and management of such acquired defects in the maxillofacial region.

ROLE OF PROSTHODONTIST IN REHABILITATION OF MAXILLOFACIAL COMPLEX

A maxillofacial prosthodontist is an eminent member of a multidisciplinary team. They contribute towards a wide array of treatments to rehabilitate the speech, mastication, deglutition and esthetics post-surgery. Maxillofacial prosthesis is a non-surgical, non-invasive mode of treatment indicated in patients with a large soft and hard tissue deformity, advanced age, in areas with poor blood supply, high recurrence rate and in patients undergoing radiotherapy [6].

As a critical member of the multidisciplinary team, the maxillofacial prosthodontist co-ordinates with the entire team of specialists to deliver a holistic treatment plan to the patient [7]. A prosthodontist must

- Monitor the medical health of the patient;
- Provide surgical stents to aid in post-operative recovery;
- Help plan a precise surgical technique with the surgeon, to preserve the anatomical structures which contribute to retention, stability and support for the prosthesis;
- To communicate with the radiation oncologist, to determine the prognosis of hard and soft tissues and recommend appropriate treatment plan pre and post radiation;

- To co-ordinate with the speech pathologist, to incorporate the requirements of resonance, phonation and articulation in the prosthesis.
- Counsel the patients regarding the possible short term and long term complications of chemotherapy and radiotherapy.
- Educate the patients on post-surgical oral hygiene methods and therapeutics to preserve oral health and rehabilitate the post-surgical wound with prosthesis.
- Prosthodontist should follow up the patient to minimize the chances of recurrence.

PRESURGICAL PROSTHODONTIC INTERVENTION

A comprehensive oral and dental examination should be part of the presurgical intervention. Presurgical records such as articulated diagnostic cast, jaw relation records, profile template of the midline of face, matching tooth shape and shade, radiographs, photographs of the mouth and face from strategic angles, facial moulage may be obtained for optimum post treatment outcome [8].

Oral bacterial load should be reduced by extracting teeth with poor prognosis, restoration of teeth that has to be retained to support the prosthesis, modification of oral structures to anticipate the needs of subsequent treatment procedures such as alveoloplasty, gingivoplasty etc. may be required, as time permits [9]. Existing dental prosthesis may be modified to serve as treatment prosthesis or preparation of surgical stents. Thus, an optimum oral environment should be maintained in order to provide freedom from infection and facilitate early recovery of tissues. Nutritional and psychological assessment and intervention should be included in the protocol [10].

POSTSURGICAL PROSTHODONTIC REHABILITATION OF ACQUIRED DEFECTS

After surgical excision, rehabilitation of the acquired defects is critical to restore the normal health of the patients. The defects can be broadly divided into –

Intra Oral Defects

- Maxillary Defects
- Soft Palate Defects
- Mandibular Defects
- Tongue Defects

Extra Oral Defects
Auricular Defects

- Nasal Defects
- Ocular/Orbital Defects

Rehabilitation of maxillary defects

Acquired defects of the palate may be in the form of a small opening resulting in communication from the oral cavity into the maxillary sinus, or it may include floor of the nasal cavity, alveolar ridge, portion of the hard and soft palate. Patients with such deformities present with fluid leakage through the nose, impaired mastication and hypernasal speech. The functional anatomy of the defect should be evaluated to plan the prosthetic rehabilitation of the patient [11]. Among the various classification systems, Okay's classification system guides us determine the extent of defect and accordingly design a surgical obturator (Figure-1) [12]. Smaller defects can be corrected with microvascular osseocutaneous flaps, while larger defects require a prosthetically constructed customized device termed as a maxillary obturator. An obturator is a disc or plate used to close an unnatural opening or defect. On placement, these obturators provide improvement in speech articulation, voice quality, swallowing and alongside restore the midfacial contour by supporting the lips and cheeks. Over the years, different types of obturators such as silicon bulb obturators, implant supported obturators and cast metal obturators have been used [13].

An obturator is made in three phases, with each achieving distinct objectives:

- **Surgical obturator** – Fabricated in the preliminary phase from a preoperative cast, based on the surgical boundaries and radiographic examination (Figure-2). The objective of this obturator is to separate the nasal cavity from the oral cavity which facilitates patients to speak and swallow, provide support for surgical packing, support the split thickness skin graft, and minimize wound contamination. This is inserted at completion of resection.
- **Interim/Provisional obturator** – It is modified from a surgical obturator to accommodate the tissue changes, with addition of clasps to improve the midfacial support and esthetics.
- **Final /Definitive Obturator** - This is fabricated six months to one year of post-operative healing. This obturator allows maximum distribution of forces to the remaining hard and soft tissues (Figure-3).

With the advent of zygomatic implants, and its usage in the reconstruction of larger defects involving the orbital floor or zygoma, implants have emerged as a more predictable and reproducible protocol for the rehabilitation of maxillary defects in edentulous patients. This approach has reported a low complication rate and a higher health related quality of life (HRQoL) index in comparison to patients who have undergone a free flap reconstruction [14]. It would be ideal if fixed prosthesis could be given in all the patients who have

undergone surgical resection. Some of the reported complications include sinus infections, oroantral fistulae, facial pain, and implant failure. The success rate of implants into grafted bone is 76% to 84%, whereas Branemark recorded a success rate of 97% with zygomaticus implant [5].

Rehabilitation of soft palate defects

Soft palate elevates to contact the lateral and posterior pharyngeal walls of the nasopharynx to close the palatopharyngeal orifice. Surgical resection involving the soft palate alters the function of the remaining structures to provide a palatopharyngeal closure [15]. Different types of obturators given [15, 16]:

- **Pharyngeal obturator/ speech bulb prosthesis** - Given to correct the palatopharyngeal insufficiency. It extends into the pharynx, separates oropharynx and nasopharynx thus restores the soft palate defect.
- **Meatus Obturator** - In an edentulous patient, a meatus obturator with a distal extension is designed to close the posterior nasal chonchae. A drawback with this type of prosthesis is that it tends to make the patient's speech hyponasal, which can be altered by creating holes in the prosthesis.
- **Palatal lift prosthesis** – It is indicated in patients with speech disorders due to palatopharyngeal incompetency. Nonfunctional or inadequately functioning pharynx results from fibrosis following surgeries or irradiation of the area. This prosthesis elevates the soft palate to the correct superior position; enabling velopharyngeal closure by the actions of pharyngeal walls. A speech pathologist is involved in training a patient to use the prosthesis to advantage.

Rehabilitation of mandibular defects

Rehabilitation of a disability resulting from resection of pathologies associated with tongue, floor of the mouth, mandible and adjacent structures is a challenging task to a prosthodontist.

These defects are classified based on the amount of resection and extent of bone loss as continuity and discontinuity defect. Mandible is reconstructed to re-establish continuity by intermaxillary fixation, sectional dentures, mandibular guidance appliances or resection prosthesis. Mandibular resection prosthesis is fabricated after initial healing is complete and patient is able to open and close the mouth adequately. This prosthesis uses a guidance flange or a maxillary occlusal platform to guide the mandibular segment into occlusion. The design depends on number of teeth present. In partially edentulous patients, a major connector, occlusal rest, guide planes are designed to gain maximum support from adjacent tissues. In edentulous patients, an occlusal ramp is added to the palatal side of the maxillary denture to guide the mandible into proper position [17].

Rehabilitation of Glossectomy Defects

Tongue plays a pivotal role during the production of all phonemes except bilabial, labio-dental and glottal sounds. Tongue movements modify the shape of the oral cavity and change the resonance characteristics that produce different consonants. After resecting the defect involving the floor of the mouth, defect is reconstructed with local soft tissue graft or microvascular free tissue transfer. Despite which the tongue movements are still restricted resulting in difficulty in mastication, deglutition and speech. Patients often require partial or complete reconstruction of tongue defects to restore these functions. Factors influencing the prognosis of restoring the tongue with prosthesis depend upon the presence or absence of teeth and the type of procedure that is combined with the glossectomy [18].

- **Total glossectomy in completely edentulous patients** - Total glossectomy creates a concave shaped floor of the mouth. Tongue is rehabilitated with a mandibular denture lingual flange extending over the floor of the mouth with a mushroom shaped button attached to it on to which silicon tongue can be placed. Two prosthetic tongues can be made, one for phonetics and the other for swallowing.
- **Total Glossectomy in Hemimandibulectomy patients** - If mandible is resected along with tongue, loss of continuity leads to deviation of the residual segment towards the resected side. Mandible is reconstructed with bone graft, followed by implant retained overdenture attached with tongue prosthesis. Alternatively, maxillary complete denture and mandibular complete denture with guiding flange which will close the defect.
- **Hemi Glossectomy in dentulous or partially edentulous patients** - A maxillary partial denture with palatal augmentation can be given to restore the lost parts. Additionally if mandible is resected, mandibular cast partial denture with a guiding flange is designed to extending onto the non-defect side (Figure-4).

Extra Oral Defects

The facial prosthesis are constructed in four stages;

- Moulage impression and working cast fabrication,
- sculpting and formation of the pattern, including color match,
- mold fabrication
- Processing of the prosthesis with intrinsic and extrinsic coloration.

Rehabilitation of Auricular Defects

Auricular rehabilitation is done using the following approaches:

- Reconstruction with an adhesive retained prosthesis or an implant retained prosthesis (Figure 5a & 5b).
- Reconstruction using autologous rib cartilage or porous polyethylene.

Prosthetic rehabilitation of the missing or altered ear is the most conservative method of correcting auricular deformity and provides excellent cosmetic results. In fabrication of an auricular prosthesis, tragus is the preferred landmark for an accurate placement of the prosthesis by the patient. Flat or concave base, devoid of hair is considered a good base for adhesion. With the use of adhesive-retained auricular device, patients reported allergic reactions to the adhesive, less retention and difficulty in maintenance. To improve the retention of auricular prosthesis, specifically designed craniofacial implants can be placed in the mastoid or temporal bone using any of the three retentive systems: the bar and clip, the ball and keeper and the magnet and keeper. Cost and fear of surgical intervention are the main limiting factors for a patient to opt for implant retained prosthesis [5, 19].

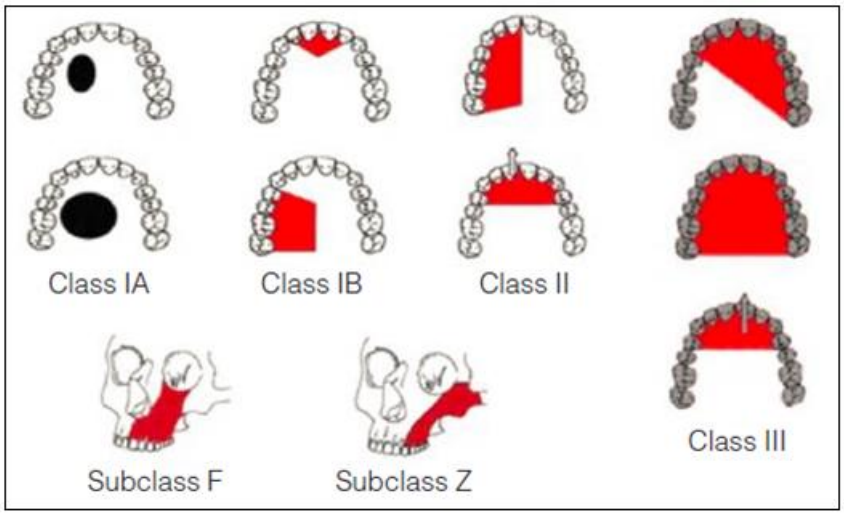

Fig-1: Classification according to Okay *et al.*,

Fig-2: Immediate Surgical Obturator

Fig-3: Maxillary obturator to restore the contours of the resected palate and recreate the functional separation of the oral cavity, sinus, and nasal cavity

Fig-4: Tongue Prostheses

Fig 5(a) & (b): Implant retained auricular prosthesis

Rehabilitation of Nasal Defects

Among the facial defects, nasal defects produce severe cosmetic impairment. Rehabilitation of such defects includes surgical, provisional and definitive prosthesis subsequent to surgery. Presurgical photographs can aid in an accurate replication of the patient's original nose. Prosthesis can be made from acrylic or silicone. Retention of the device depends on the amount of nasal bone and anterior nasal spine preserved. The presence of mobile tissues in the defect, nasal secretions, and moist air associated with respiration will limit the adhesion of the prosthesis. After the resection, if the remaining bone support is optimum in the anterior floor of the nose and maxilla region, an implant retained prosthesis is preferred as the retention will be superior compared to the removable prosthesis [20, 21].

Rehabilitation of Orbital/Ocular Defects

Loss of eye, along with contents of the orbit may result from tumor ablative surgery, trauma, or burns, and may negatively affect social and psychological wellbeing of the patient. Design of the prosthetic appliance varies with the type of surgical resection. In orbital excenteration defects, it is difficult to reproduce the facial expressions around the margins. Such defects are corrected in conjunction with plastic surgery procedures. Implants can be placed along the supraorbital rim or lateral rim of the residual orbit. Orbital prostheses fabricated from silicone, are retained by mechanical means such as spectacles, or adhesives [22].

Use of prosthodontic splints and stents in radiotherapy

Prosthodontic splints and stents are used to minimize the morbidity of tissues resulting from radiotherapy. This prosthesis are used to protect or displace vital structures, locate diseased tissues in repeatable position during treatment, position the beam, carry radioactive material or a dosimeter device to the tumor site, and to recontour tissues to simplify dosimetry and shield tissues. They help minimize the masticatory muscle stiffness and temporomandibular joint fibrosis. Devices such as bite openers aid the patient in maintaining the mouth open to eat and maintain oral hygiene [23].

ADVANCES IN MAXILLOFACIAL PROSTHESIS

Over the years the use of computer-aided design/computer aided manufacturing (CAD/CAM) technology has revolutionized the practice of dentistry. CAD/CAM supplemented with 3D bioprinting has increased the consistency and efficacy of fabricating prosthesis. The protocol for craniofacial prosthesis design includes data capture and patient-specific design on a virtual platform, followed by fabrication and placement of the prosthesis. The defect must first be digitally analyzed by using 3D laser scanning to plan for prototype design. The mould and substructure of the prosthesis can subsequently be designed using the numerical and visual data acquired from laser scans obtained from different angles. The planning phase with 3D software also can provide a model for patient-specific surgical templates, and serve as a visual analog to educate patients during consultation appointments prior to the procedure. In vivo stability, durability, and esthetics of the prosthesis are significant factors that ultimately determine procedural success [24].

CONCLUSION

Rehabilitation of post-surgical defect after trauma and surgical resection of pathologies requires a multidisciplinary approach. It is a challenging task for a maxillofacial prosthodontist to rehabilitate the defects due to unpredictable nature of the defects. Over the years many devices have been fabricated to rehabilitate the defects and improve the overall quality of life. Future research needs to done in the field of tissue engineering to develop newer scaffold materials with improved mechanical properties to provide tissue morphology and enhanced chemical properties. Developing patient centered rehabilitation models, proposing evidence based guidelines through coordinated efforts of interdisciplinary teams should be on the agenda to achieve long term survival of the patient.

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