Literature Review: Concept of Maxillofacial Prosthetics

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Abstract

Introduction: Maxillofacial deformities can be unesthetic and can represent in the form of congenital, developmental, post ablative surgery, and traumatic defects which may be embarrassing to the patient. These defects not only compromise with appearance but also the functional and psychological health of the patient. It negatively affects the social life of the patient as well as severely alter the quality of life posing them to severe psychiatric, social and familial problems. The deformities can vary from malformation and developmental disturbance (congenital), pathologies (acquired) and post-trauma and oncosurguries. The ultimate prognosis depends on the type and extent of the defect. Surgical reconstruction by free flaps is usually the choice of treatment but with more advancement in prosthetic rehabilitation, it has become a choice of treatment over surgical intervention due to certain advantages such as observation for recurrence of the certain tumor and other pathologies, technical simplicity, esthetic superiority and cost-effective. Thus, the procedural complexity of surgical reconstruction and post-surgical complications is making it a less preferable choice of treatment. In the past, many decades’ several prostheses have been developed for the correction of the maxillofacial defect but the successful treatment will ultimately depend on the correct diagnosis and skill-full decision of the clinician.

Aim of the Study: The review represents the different maxillofacial prosthetics used in different debilitating conditions, the aim of the study is to understand the origin and development, different materials and techniques available for the fabrication of maxillofacial prosthetics.

Methodology: The review is a comprehensive research of PUBMED since the year 1983 to 2019.

Conclusion: The rehabilitation of maxillofacial defects can be very challenging in the field of maxillofacial prosthodontics. A carefully planned prosthetics with sophisticated techniques can finally improve the structural and functional defects. The work of the surgeon and prosthetic specialist are closely allied for full rehabilitation of the patient. The prosthodontist involved should be aware of the situation so that a better service is rendered to the patient.

Keywords: Maxillofacial Prosthetics; Intra-Oral Prosthetics; Extra-Oral Prosthetics; Fabrication Technique

Introduction

Maxillofacial prostheses have an important role in the quality of life and self-esteem of a patient, as defects can be immediately corrected after surgical procedure. These prostheses allow an individual to integrate themselves again in their social and familial life, making them more confident and happy. The success of these prostheses depends on the combined work of different health professionals such as doctors, nurses, psychologists, physiotherapists, speech therapists and dentists for prosthetic rehabilitation [1].

Ackerman (1953) defined maxillofacial prostheses as a phase of dentistry that repairs and artificially replaced parts of the face after facial trauma or surgical intervention. However, this definition excluded the use of prostheses in congenital craniofacial defects. The maxillofacial reconstruction involves substitutes for intraoral and extraoral structures such as eyes, ears, nose, maxilla, mandible, palate,
esophagus, and cranial bones. They are primarily fabricated using acrylic resin or silicone material and retained to facial deformities by implants or adhesives or supported by body cavities and teeth [1].

According to GPT 9, prosthesis is defined as “An artificial replacement of part of the human anatomy restoring form, function, and esthetics” [2].

Goals of maxillofacial prostheses are [3]:

- Restore aesthetics and cosmetic appearance
- Restore function
- Impart therapeutic or healing effect
- Protection of tissues
- Psychological therapy.

**Classification of maxillofacial prostheses [4]**

<table>
<thead>
<tr>
<th>Intraoral Prostheses</th>
<th>Extraoral Prostheses</th>
<th>Combination</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maxillary Defect:</strong></td>
<td>Orbital Prostheses</td>
<td>Orbito-Maxillary</td>
</tr>
<tr>
<td>Soft Palate: Speech Appliance, Meatus Obturator, Palatal Lift Prostheses</td>
<td>Auricular Prostheses</td>
<td></td>
</tr>
<tr>
<td><strong>Mandibular Defect:</strong></td>
<td>Mid-Facial Prostheses</td>
<td></td>
</tr>
<tr>
<td>Mandibular Resection Prostheses, Guide Flange Prostheses</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Glossectomy:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tongue Prostheses, Palatal Augmentation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Splints/Stents:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgical Splints, Bite Splints, TMJ Appliance.</td>
<td></td>
<td></td>
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</tbody>
</table>

**Table 1**

**Intraoral prostheses**

**Obturators**

According to GPT 9, “obturator that component of prostheses that fits into and closes a defect within the oral cavity or other body defects” [2] obturator can be used for both acquired and congenital defects such as the cleft palate and simple plate type of obturator are given to infants so as to aid in feeding. A palatal lift prosthesis or an overlay or superimposed denture is also fabricated to render normal oral function. For acquired defects such as surgical intervention, traumatized tissues require surgical, interim and definitive obturators which can be given to both dentulous and edentulous patients. This aids in feeding, keeping surgical site clean, to improve speech, increase tissue healing, improve deglutition and mastication, keeping lip and cheek in correct position, to reshape and reconstruct palatal contour and to reduce the flow of nasal exudates into the mouth [5].

The surgical obturator is usually fabricated for a surgical guide to be used during surgery and is done prior to the resection of maxilla. It is attached to maxilla after resection surgery to restore form and function and secure surgical dressing or packs in place. For the edentulous patient, the denture can serve as a surgical guide during surgery and is reattached to maxilla using ligature wires to secure surgical dressings. While for the dentate patient, a simple, clear acrylic baseplate is used as a guide during surgery and as an obturator post-surgery. During fabrication, the resected area is marked on cast and teeth are removed from that side; wire and clasps are fabricated for retention on the remaining teeth and baseplate are fabricated. A surgical obturator can be modified to interim obturator by the placement of acrylic teeth and can be worn for a period of 6 - 12 weeks, after which a definitive obturator is required. It usually has a metal framework and cast clasp with a hollow bulb obturator and can be a single piece or two-piece appliance [6].

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Speech Aid prostheses or Pharyngeal Obturator or Speech Bulb Prostheses are obturators used for defects involving soft palate defects. Palatoopharyngeal insufficiency develops when there is ineffective closure of soft palate and one or more pharyngeal walls during swallowing or speech sounds that would require a high intraoral pressure, which is due to anatomic deficiency or myoneural deficiency. This defect makes the palatopharyngeal sphincter incomplete, results in excessive nasal airflow and inadequate pressure affecting speech and nasal regurgitation during feeding. For this condition, a speech bulb prostheses are an ideal choice since it's a removable prosthesis to restore the defect of the soft palate with a portion extending into the pharynx; this separates oropharynx and nasopharynx during phonation and deglutition and artificially completing the palatopharyngeal sphincter [8].

Unlike speech bulb obturator, the meatus obturator is independent of surrounding muscle activity to provide separation between oral and nasal structure. But since it is not located in the region of muscle activity it is not effective in speech refinement. Thus it is not recommended in cleft patients. Palatal lift prostheses are used to improve the dysfunction of soft palate by placing soft palate in contact with lateral and posterior pharyngeal walls to prevent the escape of nasal air during speech and also preventing regurgitation food and liquid [10,11].

Prostheses for mandibular defect

Mandibular Resection Prostheses- mandibular defects post-trauma, surgery, osteoradionecrosis, and infections can cause significant facial deformity and functional disabilities. On the loss of mandibular continuity, the lower occlusal plane rotates inferiorly to the defect side. Rotation along the fulcrum leads to anterior open bite and supraphyoid muscle pulls the residual mandible and causes inferior displacement. The deviation in mandible while the opening of the mouth is due to the uncompensated influence of contralateral musculature such as internal pterygoid muscle and pull from cicatricial tissue on the resected side. Mandibular guidance prostheses are widely used for the correction of such defects, the goal of which is to re-educate the mandibular muscles to re-establish an occlusal relationship [12].
Tongue prostheses

The tongue is a common site of oral carcinomas, of which the postero-lateral part commonly involved. This often requires surgical excision and resection in severe cases leading to functional impairment. In such patients, tongue prosthesis becomes necessary to restore the form and function of oral cavities such as improve resonance, decrease the pooling of saliva, protection to underlying mucosa, easy passage of food down the oropharynx, speech and psychosocial adjustment. In the case of partial glossectomy, the remaining tongue is attached to the floor making speech and deglutition difficult because of the limited movement of the tongue. The patient can be benefited from palatal prostheses which will lower the palate and allow the tongue to come in contact, which in turn restores the oral functions [14].

Figure 4: Figure showing A. Palatal augmentation prostheses, B, and C, are showing tongue prostheses [15].

Surgical splints and bite splint

The surgical splint is used to guide the surgeon during surgery, and the same can be further used for support to the operated area until completion of healing. Bite splints are used for stabilizing bite in a particular position that is most suitable for existing dentition [16].

TMJ appliance

These appliances are used for relieving trismus and thereby increasing mouth opening. They are known as “jaw exercisers” and effect on joint and associated muscles and ligaments. They cause a forceful opening of jaw and strengthens the masticatory muscles [17].

Extraoral prostheses

Nasal prostheses

Full-thickness nasal defects due to the deeply invasive cutaneous tumor, trauma, infection (leprosy) and extensive rhinectomy done for surgical treatment are not uncommon these days. The absence of the nasal pyramid severely affects the esthetic and facial symmetry. The first step includes taking an impression of the affected area using a high-fluidity condensation cured silicone for a precise imprint. The cast is then made using dental plaster onto which hot modeling wax is molded in the form of a nasal prosthesis known as a preliminary model and is directly tried on the patient for any adjustment. The second plaster mold is made and wax is melted off. The final prosthesis is proceeded for casting using colored heat-cured medical silicone. The natural pigment is mixed in fluid silicone so it blends well with neighboring tissues and skin. The heat treatment fixes the definitive skin color on the prosthesis. The fixation of the prosthesis can be done in by a glue/adhesive, by an implant fixed onto eyeglass frame, clip or magnetic fixation with bone anchorages (implants) and, existing undercut in the operated area [18].

Figure 5: Figure A. showing full-thickness dorsum nasal defect and B. Nasal prostheses glued in position [18].
A congenital defect, trauma, or a painful blind eye may lead to a loss or absence of an eye. This leads to a loss of orbital volume which requires orbital prosthesis to minimize any socket changes, maintain the shape of fornices, and prevent scar contractures during healing. The replacement procedure begins after the complete healing post eye enucleation procedure. The first step is evaluation and inspection of defective socket and diameter of pupil and iris of the intact side is measured. A direct impression is made using irreversible hydrocolloid after lubricating the eyebrow and eyelashes. The cast is poured by dental plaster and a wax model of the similar contour of the globe is fabricated. This wax model is invested in dental stone type-II. Autopolymerizing acrylic resin is used. Iris disk is painted using acrylic based pigment. The blood vessels are placed on sclera for a more natural look. After complete fabrication the final surface contour and skin texture are established by carving lines and making wrinkles around the eyes, using intrinsic colours the prosthesis is processed in first mold assembly, post-polymerization the residual flush is trimmed and finished using abrasive stones [19].

**Orbital prostheses**

**Figure 6:** Figure showing A. total nasal pyramid defect B. Nasal prosthesis mounted with eyeglass frame [18].

**Auricular prostheses**

The ear can be congenitally missing or can be lost due to accidental trauma or malignant carcinoma. The anomaly of the ear is known as Microtia which may include from normal but small ear to complete absence of the ear. Surgical reconstruction can be very challenging since the exact morphology of the opposite side is hard to achieve by most of the plastic surgeons. Hence, prostheses fabrication becomes the most conservative method for the correction of such deformity. The commonly used technique is similar as mentioned for nasal and ocular prostheses. The wax pattern of the contralateral ear is made after impression and pouring cast. The silicone-based material and acrylic used for the fabrication of prostheses [20].

**Figure 8:** Figure showing A. Complete absence of ear B. Fabricated auricular prostheses C. prostheses in use with eye frame [20].

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The midfacial defect and combination defects may involve the entire maxilla and nasal defect or maxillary and orbital defect or naso-maxillary-orbital defect. The fabrication of prosthesis is similar to above with the fixation of the prosthesis using integrated implants. The adhesive is not a choice of fixation because of the bulk prosthesis and large defect [4].

**Figure 9:** Figure showing A. and B. extensive orbito-palpebro-nasal defect corrected using implant-based prostheses. C. extensively damaged mid-face including eye, mid-face and nose. D. Try-in of wax prosthesis E. Placement prostheses using eyeglass frame with a nasogastric feeding tube [18,21].

**Conclusion**

A wide variety of orofacial defects may occur due to congenital deformities and acquired in the form of accident and highly invading tumor causing extensive damage to the oro-facial structure. The condition not hamper with the maintenance of oral function and aesthetics but also impart a deep psychological effect on the patient. Surgical construction not always a feasible option in many cases. Maxillofacial prostheses thus provide an optimum closure or such defects and restore form, function and esthetics. The treatment modality is ancient and has developed over a period of time. With more advancement in materials and technique, maxillofacial prostheses can be one of the promising and successful treatment options of orofacial defects.

**Bibliography**


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