

## MAXILLOFACIAL PROSTHESIS

**Maxillofacial Prosthetics:** the branch of prosthodontics concerned with the restoration and/or replacement of the stomatognathic and craniofacial structures with prostheses that may or may not be removed on a regular or elective basis.

**Maxillofacial Prosthesis:** is an artificial device or any prosthesis used to replace part or all of any stomatognathic and/or craniofacial structure.

**Maxillofacial defects may be caused by** congenital, trauma or surgical resection of tumor.

### Indications of maxillofacial prosthesis:

1. When plastic surgery is contraindicated.
2. When recurrence of malignancy is expected.
3. When radiotherapy treatment, radium appliance and radium protector shield can be used.
4. Temporary maxillofacial Prosthesis used when plastic surgery requires various steps.

### Objectives of maxillofacial prosthesis

1. Improve or restore the esthetics or cosmetic appearance of the patient which is of prime importance for everybody.
2. Improve or restore the functions that include:
  - a. Speech functions in patient with palatal lost part of the jaw.
  - b. Nutritional function in patient with lost part of the jaw.
  - c. Avoid escape of food to nasal cavity in children with cleft and overcome feeding problem
3. Protect the tissues:
  - a. To protect the adjacent tissue as in radium protective, also to protect wound, stop bleeding and carry medication after surgery.
  - b. Protect the teeth as in mouth guard contact sport.
4. Therapeutic or healing effects by placement of radium applicator.
5. Physiologic therapy: to raise the moral of patient + Help in healing fracture segments.

**Maxillofacial team member**

1. Plastic surgeon
2. Radiotherapist.
3. Dental specialists.
4. Prosthetic.
5. Oral surgeon.
6. Orthodontist.
7. Dental technician.
8. ENT specialist.
9. The psychiatrist.
10. Social workers.
11. Neurologist
12. Psychiatrist.

**Maxillofacial Classification**

**Acquired defects:** Include those that are the result of trauma, or of disease and its treatment. These may include a soft and/or hard palate defect resulting from removal of a squamous cell carcinoma.

**Congenital defects:** are typically craniofacial defects that are present from birth. The most common of these include cleft defects of palate that may include the premaxillary alveolus.

**Developmental defects:** are those defects that occur because of some genetic predisposition that is expressed during growth and development.

Another helpful way to classify maxillofacial patients is by the location of prosthesis

- Extraoral (cranial or facial replacement).
- Intraoral (involving the oral cavity).
- Intraoral and Extraoral: Lost part of maxilla or mandible with facial extension.

**Extra Oral Appliances**

1. Nasal prosthesis
2. Auricular prosthesis
3. Orbital Prosthesis
4. Radiation Carrier
5. Cranial prosthesis.
6. Carrier St

**1. Nasal prosthesis:** A removable prosthesis attached to the skin which artificially restores part or all of the nose. Fabrication of a nasal prosthesis requires creation of original mold. Additional prostheses usually can be made from the same mold, and assuming no further tissue changes occur, the same mold can be utilized for extended periods of time.

**2. Auricular prosthesis:** An artificial ear produced from a previously made mold. Unfortunately, the presence of hair and the absence of anatomic irregularities often result in unfavorable adhesive retention of auricular prosthesis. Endosseous implants may permit positive retention of auricular prosthesis.

**3. Orbital Prosthesis:** • Loss of eye is emotional and physical problem to the patient.

• An orbital prosthesis is created to restore a more normal anatomical structure and cosmetic defect created by these conditions in a person. This type of restoration need retention means by implant especially when the defect is large.

**4. Cranial prosthesis:** A biocompatible, permanently implanted replacement of a portion of the skull bones.

**5. Radiation Carrier:** A device used to administer radiation to confined areas by means of capsules, beads, or needles of radiation emitting materials such as radium or cesium. Its function is to hold the radiation source securely in the same location during the entire period of treatment. Radiation oncologists occasionally request these devices to achieve a close approximation and controlled application of radiation to a tumor deemed amiable to eradication. Synonymous, Radiation Applicator, Radium Carrier, Radiotherapy Prosthesis.

**6. Carrier Stent:** It is used to carry skin or mucous membrane graft in vestibule, palate or mouth floor in approximation to periosteum during initial healing and prevent formation of hematoma between the graft and the underlying bone and periosteum.

### **Intra Oral Appliances**

- 1. Obturator.**
- 2. Feeding prosthesis**
- 3. Mandibular prosthesis.**
- 4. Speech prosthesis.**
- 5. Palatal lift prosthesis.**

**1. OBTURATOR:** A maxillofacial prosthesis used to close, cover or maintain the integrity of the oral and nasal compartments resulting from a congenital, acquired or developmental disease process, i.e., cancer, cleft palate, osteoradionecrosis of the palate. The prosthesis facilitates speech and deglutition by replacing those tissues lost due to the disease process and can, as a result, reduce nasal regurgitation and hypernasal speech, improve articulation, deglutition and mastication.

An obturator prosthesis is classified as surgical, interim or definitive and reflects the intervention time period used in the maxillofacial rehabilitation of the patient.

### **Functions of obturator**

1. Feeding purpose.
2. Maintains the wound/defective area clean and hold dressings or packs post surgically in maxillary resections.
3. Enhances the healing of traumatic or post-surgical defects.
4. Helps to reshape/reconstruct the palatal contour and/ or soft palate.
5. Improves speech.

### Surgical obturator

A temporary maxillofacial prosthesis inserted during or immediately following surgical or traumatic loss of a portion or all of one or both maxillary bones and contiguous alveolar structures (i.e. gingival tissue, teeth).

- ✓ The Surgical obturator is secured either by palatal screw, suture or circumzygomatic wires.
- ✓ Old denture can be used as a surgical obturator but it might create some problems because the denture mostly not fit as before surgery therefore relining may help to improve patient's acceptance and tolerance.
- ✓ It is mostly used for 10 days more or less depends on treatment plane.

### Advantages of surgical obturator:

1. Provides a matrix on which the surgical packing can be placed.
2. Reduces oral contamination of the wound and the incidence of local infection.
3. Enables the patient to speak more effectively by reproducing normal palatal contour and by covering the defect.
4. Permits deglutition, thus the nasogastric tube may be removed at an earlier date.
5. Lessens the psychological impact of surgery by making the post-operative course easier to tolerate.
6. Reduces the period of hospitalization.

### Interim Obturator

The temporary obturator is constructed from post-surgical impression cast which has a false palate and false ridge and generally no teeth. Every step of prosthesis construction must maximize prosthesis adaptation to enhance retention and stability to ensure optimum function, esthetic, occlusion, and correct jaw relations.

- The closed bulb extending into the defect area is hollow.
- The patient is usually seen every 2 weeks because of the rapid soft tissue changes that occur within the defect during organization and healing of the wound.

- Correction of tissue – prosthesis relation can be made by relining.
- The temporary obturator will need to function comfortably for as long as 6months.
- The timing depending on the size of the defect, the progress of the healing, presence or absence of teeth.

### Definitive obturator

A maxillofacial prosthesis that replace part or all of the maxilla and associated teeth lost due to surgery or trauma. It is made when it is deemed that further tissue changes or recurrence of tumor are unlikely and more permanent prosthetic rehabilitation can be achieved, it is intended for long term use.

### Reasons for doing constructing new definitive obturator:

1. The periodic addition of interim lining material increases the bulk and weight of the obturator and this temporary material may become rough and unhygienic.
2. If the anterior teeth are included in the resection, the addition of anterior denture teeth to the obturator can be of great psychological benefit to the patient.
3. If retention and stability are inadequate, occlusal contact on the defect side may result in improvement of these aspects.

### Aramany's classification for partially edentulous maxillectomy dental arches:

**Class I**—midline resection.

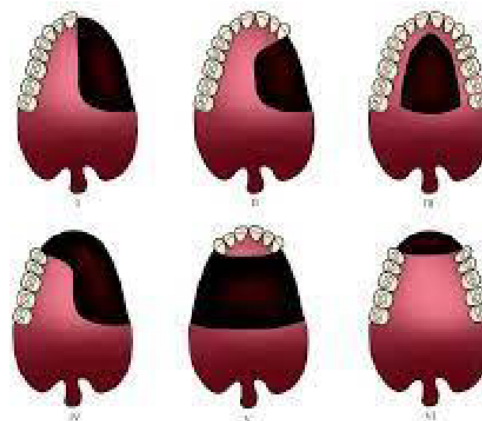
**Class II**— unilateral resection.

**Class III**—central resection.

**Class IV**—bilateral anteroposterior resection.

**Class V**—posterior resection.

**Class VI**— anterior resection.



## 2. Feeding Prosthesis: feeding aids

- Maintain right and left maxillary segments of an infant cleft palate patient in their proper orientation until surgery is performed to repair the cleft.
- It closes the oral nasal cavity defect, thus enhancing sucking and swallowing.

**3. Speech Aid Prostheses:** The defining characteristics of speech aid prostheses are that they are functionally shaped to the palatopharyngeal musculature to restore or compensate for areas of the soft palate that are deficient because of surgery or congenital anomaly. Such a prosthesis consists of a palatal component, which contacts the teeth to provide stability and anchorage for retention; a palatal extension, which crosses the residual soft palate; and a pharyngeal component, which fills the palatopharyngeal port during muscular function, serving to restore the speech valve of the palatopharyngeal region.

**4. Palatal lift prosthesis:** The defining characteristic of a palatal lift is that it positions a flaccid soft palate posteriorly and superiorly to narrow the palatopharyngeal opening for the purpose of improving oral air pressure and therefore speech. Patients who exhibit a structurally normal soft palate and pharyngeal port can demonstrate hypernasal speech caused by paralysis of the regional musculature. This condition is referred to as palatopharyngeal incompetence because the failure lies in function, not in anatomic deficiency.

**5. Mandibular resection prosthesis:** Resection prostheses are those prostheses provided to patients who have acquired mandibular defects that result in loss of teeth and significant portions of the mandible. Mandibular resection results in defects that may preserve mandibular continuity or may result in discontinuity defects. These are further subclassified by Cantor and Curtis and provide a meaningful foundation for a discussion of removable prosthesis design considerations.

### **Cantor and Curtis classification of mandibular resection:**

**Type I Resection:** In a type I resection of the mandible, the inferior border is intact and normal movements can be expected to occur.

**Type II Resection:** In the type II resection, the mandible is often resected in the region of the second premolar and first molar.

**Type III Resection:** A type III resection produces a defect to the midline or farther toward the intact side, leaving half or less of the mandible remaining.

**Type IV Resection:** A type IV resection would use the same design concepts as type II or III resections with the corresponding edentulous areas.

**Type V Resection:** In the type V resected mandible, when the anterior or posterior denture-bearing area of the mandible has been surgically reconstructed, the removable partial denture design is similar to the type I resection design.



### Retentive Aids in Maxillofacial Prosthodontics

The Dentist in general and Prosthodontist in particular has a major role in maxillofacial prosthetics because of his knowledge of anatomy, physiology and pathology as well as his skill and experience in using materials that are compatible with the patients remaining tissues. However, the Prosthodontist is limited by inadequate materials available for facial restorations, movable tissue beds, difficulty in retaining large prosthesis, and the patient's capability to accept the final result.

### Retention Methods:

#### 1. Anatomic Retention

**Intraoral retention** includes the use of both hard and soft tissues-teeth and mucosal and bony tissues. Anatomic undercut areas are a welcome feature in the postsurgical case. They may be found in the palatal area, cheek, retromolar, labial, septal, posterior nasal pharyngeal or anterior nasal spine areas. Additional aids to anatomic retention include proper occlusion, proper post dam, and surface adhesion.

**Extraoral retention** necessitates the use of both hard and soft tissues of the head and neck area. Examples would be any bony wall of a defect with which part of the prosthetic device will come in contact or a cartilaginous remnant of the ear. Soft tissues prove to be more troublesome because of their flexibility, mobility, lack of bony nasal support, lower resistance to displacement when a force is applied, deficiencies as a base for firmly securing the surgical adhesive during cementation.



## 2. Adhesives

The selection of a suitable adhesive involves consideration of the prosthetic materials used in the construction of the prosthesis. Several factors should be considered when selecting an adhesive system for a facial prosthesis:

1. The strength of the adhesive bond to skin and to the facial prosthetic material.
2. Biocompatibility of the adhesive.
3. Design and material of prosthesis.
4. Composition of the adhesive.
5. Type & Quality of patient's skin.
6. Convenience of handling and removing the adhesive.

Various types of skin tissue adhesives for facial prostheses are acrylic resin, latex, silicone, pressure sensitive tapes, spirit gum, water based adhesives.

### Advantages:

1. Ease of application and manipulation.
2. Readily available.
3. No need to undergo any surgical procedures.
4. Less expensive as compared to implants.

### Disadvantages:

1. It may tear at the margins.
2. Routine removal may damage external pigmentation.
3. Patients with poor dexterity or coordination may have difficulty in applying.
4. Some patients may develop allergic or irritative responses to adhesives.

## 3. Mechanical Retention

Current mechanical means for retention of facial prostheses include: -

- **Eyeglass:** A possible means of retaining a nasal prosthesis by utilizing newly designed eyeglass frames for the patients who has had the bridge of the nose surgically removed. The eyeglass frame should be opaque in color rather than translucent to prevent retention marks from becoming visible.
- **Magnets:** Magnets used widely in the retention of maxillofacial prosthesis and in different ways. The traditional over denture by implanting pole in the jaw or soft tissue and the other pole fixed inside the prosthesis.

Magnets used in the joining of large prosthesis like in the treatment of patient with total maxillectomy and limited mouth opening, the prosthesis composed of two parts and the magnets connect these parts after insertion these parts separately.

The magnets also used to connect the prosthesis with intra and extra oral parts. Magnets used for retention of extra oral prosthesis like auricle. The repulsion effect of magnets used in retention of the upper and lower dentures by fixing magnets at the posterior area of the dentures made from the same pole.

- **Cast clasps:** The most common method for retaining an intraoral prosthesis uses a cast metal clasp which enters an undercut. The properly designed and fabricated clasp will provide stability, splinting, bilateral bracing, and reciprocation, as well as retention.
- **Acrylic buttons and retentive clips:** Acrylic buttons – retained facial prostheses usually have an acrylic substructure that fits into the defect and one or more mushroom – shaped acrylic projections (buttons) attached to the substructure. The final prosthesis is fabricated so that it will snap over the mushroom buttons for retention.

Retentive clips are metallic or plastic clips that snap over the bar used as a superstructure connected to the implants. Retentive clips have more retentive ability in terms of breakaway retentive force than magnets.

- **Implants:** The successful clinical development of intraoral and extraoral implants to retain dentures and other prosthetic replacements. The retention of prosthesis to implants by using ball and socket or by using the magnets.

Intraoral prosthesis retained by using osseointegrated implants as ordinary over denture supported by implants.

Extraoral prosthesis retained by using osseointegrated implants which implanted in the facial bones to support the facial prostheses. For example, an auricular prosthesis fabrication in which osseointegrated implants were placed in the temporal bone and used a screw retained magnetic alloy casting to retain an acrylic resin magnet keeper, to which silicone ear prosthesis was attached.

### Steps of maxillofacial prostheses construction

**Primary impression:-** A gauze may be placed in the defect-undercut- area and the preliminary impression was made in stock tray using irreversible hydrocolloid as tissue were still in the healing phase. Be careful in certain cases alginate may be tear in the defect area during removal.

Silicone impression material can be used. In some cases 2 compatible impression materials can be used in modified technique. The impression must extend as possible in the defected areas. The primary cast obtained was used to fabricate a custom tray for the definitive impression. Any undercuts may interfere with tray construction must be blocked. Relief areas must be determined also.

**Final impression:** The definitive impression is made a properly extended and well-adjusted special tray was made; sectional trays or double trays technique can be used. Proper border molding and proper extension of the flanges must be established.

**Digital Impressions:** Laser surface scanning was applied to acquire three-dimensional imaging data of the patient's facial defect. Transferred to a CAD/CAM interactive program (in computer system for image processing produced a model for fabrication of the facial prosthesis.

### Jaw Relation stage:

- Minimal block out made because excessive block out result in unstable record base.
- Improve esthetic by an attempt to compensate for loss of facial support on the defect side.
- Occlusal plane and wax level is difficult in most cases due to the tissue scar and block out procedure. Transfer the jaw relation to the
- Semi adjustable articulator.
- Monoplane occlusion used for those patients.

**Try in stage:** In this stage should verify:

- Centric jaw relation
- Vertical dimension.
- Esthetic.

**Delivery stage:** • Use of pressure indicating paste to check for pressure areas.

- Remounting of prosthesis for occlusal adjustment.
- Give instruction to the patient to maintain good oral hygiene.

### Materials used in maxillofacial prosthesis

#### Desirable Properties:

#### Esthetic properties:

1. Matching the color of the replaced tissue or adjacent tissue (mimic natural skin).
2. Should have the natural texture and unnoticeable in public.
3. Formation the original shape of the replaced tissue by reproduction of lost structure in details.
4. Should have enough translucency to simulate the natural tissue.

#### Physical Properties:

1. Should have adequate flexibility according to the replaced area.
2. Sufficient low thermal conductivity to protect the adjacent tissue.
3. Enough edge strength to withstand the movement adjacent tissue without deterioration of restoration.
4. Should have enough dimensional stability.
5. Light in weight.

**Biological and Chemical Properties:**

1. Non-toxic non-carcinogenic and non-allergic.
2. Biocompatible.
3. Stain resistance.
4. Acceptable durability.
5. Chemically stable.

**Fabrication properties:**

1. Sufficient long working time.
2. Long shelf life.
3. Adaptable to intrinsic and extrinsic coloring.
4. Should be easily processed.
5. Stable after processing.

**Available Materials for Maxillofacial Prosthesis**

- 1 Acrylic resins.
2. Acrylic Co-polymers.
3. Poly vinyl chloride and copolymers.
4. Chlorinated polyethylene.
5. Polyurethane elastomers.
6. Silicon , elastomer-HTV ,RTV foaming silicon.

**1. Acrylic Resins**

- Preferred for restoring defects which require minimal movements. e.g. fabrication of orbital or Ocular prostheses.
- Useful in cases of rapidly changing defects where relining is .mandatory

**Advantages:**

1. Easy to work with to & maintain.
2. Durable
3. Easy to relin with a tissue conditioner or reliner.
4. Both extrinsic intrinsic & coloring can be performed.
5. Compatible with most adhesive system can be cleaned easily.

**Disadvantages:**

1. Rigidity
2. Does not have the feel of skin.
3. Poor margin esthetics.
4. Surface gloss present.

**2. Acrylic Copolymer**

- Are soft & elastic.
- Disadvantages are that it has poor edge strength, degrade in sunlight,
- Processing & coloration is difficult, and gets stained easily.

**3. Poly vinyl chloride and copolymers**

- Most widely used plastics for fabrication of MFP
- Copolymers of (more than 80%) vinyl chloride & (5%-20%) vinyl acetate
- Properties are superior to those of natural rubbers in flexibility.

**Clinical usefulness** may extend from 1-6 months

**Vinyl plastisol**

- Vinyl resins are relatively rigid in their pure state made flexible by addition of plasticizers.
- In its plastisol stage the material is a thick liquid formed by dispersion of small vinyl particles in plasticizer unfortunately, vinyl plastisol hardens with the age.

**Advantages:**

1. Inexpensive & easy to manipulate.
2. Can be remade by resoftening & reheating.
3. Hydrophilic properties.

**Disadvantages:**

1. Prosthesis made from plastisol loses its flexibility with aging become hard & distorted (short service life).
2. Degradation & destruction by UV light.
3. Metal molds are used which are expensive.
4. Stains easily.

**4. Chlorinated polyethylene**

- It is material similar to polyvinyl chlorides in all properties.
- Coloration can be done using oil soluble dyes.
- Processing involves high heat curing.

**5. Polyurethane elastomers**

3 component systems

Part A - polyol

Part B- aliphatic di-isocyanate groups

Part -C initiator such as dibutyltin dilaurate or stannous octate

**Advantages:**

1. They can be made elastic without compromising edge strength.
2. Flexibility well suited to defects with movable tissue beds.
3. Colored extrinsically & intrinsically.
4. Superior cosmetic results.

**Disadvantages:**

1. Difficult to process consistently.
2. Isocyanate is moisture sensitive & toxic.
3. The presence of moisture leads to production of CO<sub>2</sub> resulting in porous elastomer and poor curing of the material.
4. Water contamination is difficult to control.
5. Requires thorough dehydration before processing if stone molds are used.
6. Poor compatibility with existing adhesive systems.
7. Difficulty in clearing adhesive from prosthesis.
8. Not color table.
9. Clinical usefulness less than 6 months ( approximately 3months).

**6. Silicones: Silicon Elastomer, HTV,RTV and Foaming Silicon****Silicon Elastomer**

Silicones are the most commonly used material for facial .restoration

**Disadvantages of silicones:**

1. Poor strength.
2. Receive colors poorly or with difficulty.
3. Some are opaque resulting in prosthesis that are cold and lifeless.
4. Microbial growth.
5. Poor wet ability.
6. Good only with silicone adhesives.

**High Temperature Vulcanized (HTV) silicone**

These silicones can be performed into various shapes for alloplastic implantation or facial prostheses.



**Advantages:**

1. Excellent thermal stability.
2. Biologically inert.
3. Color stable when exposed to ultraviolet light.

**Disadvantages:**

1. Opaque, lifeless appearance.
2. Not adequate elasticity in function.
3. Required metal molds, processing is more difficult.

**Room Temperature Vulcanized (RTV) Silicone**

There are two types of RTV silicone Condensation and Addition

**Advantages:**

1. Color stable.
2. Biologically inert.
3. Easier to process.
4. Retain physical & chemical properties at wide range of temperature.
5. Stone molds can be used.

**Disadvantages:**

1. Poor edge strength.
2. Costly.
3. Cosmetic appearance of the material inferior to that of polyurethanes, acrylic resins, polyvinyl chloride.

### Advantages of HTV over RTV

1. Less chances of air bubble ,entrapment since hand mixing of catalyst & pigments with the elastomer is avoided.
2. Increased tear strength mechanical durability & chemical resistance.
3. Increased biocompatibility and flexibility.

### Foaming Silicones

- The purpose reduced the weight of the prosthesis.
- When the catalyst is introduced to basic silicon the gas is released the gas form bubbles with in the vulcanizing silicon leaving a spongy material.
- The formation of the bubbles within the mass can cause the volume to increase by as much as 7 times.
- However, the foamed material has reduced strength and is susceptible to tearing. This weakness can be partially overcome by coating the foam with another silicone.

### Limitations of Materials:

No single maxillofacial material is ideal for every patient due to:

1. Continued effect of sunlight and vascular dilatation contraction& on the natural tissues cannot be duplicated in the prosthesis.
2. Variations of skin tone when the patient is exposed to different light sources (e.g., incandescent, fluorescent natural light) cannot be duplicated in the prosthesis.
3. The prosthesis cannot duplicate the full facial movement of the –non defective side.

