



## Review Article

# Impressions in extra-oral maxillofacial prosthesis- An overview

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### ABSTRACT

The disfigurement caused by loss of any part of the body is often a psychologically damaging experience for the patient. To gain improved fit and intimate tissue adaptation of the prosthesis, an accurate impression and fitting technique is necessary. This article reviews various impression techniques that can be used in clinical practice as and when need arises.

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## 1. Introduction

Maxillofacial disfigurement or defects can be congenital, developmental, traumatic or due to ablative surgery. These type of defects compromise the appearance and function, rendering an individual incapable of leading a relatively normal life and thereby affecting his/her psyche.<sup>1</sup>

As the quality of life is altered in these patients, social integration becomes difficult and therefore the expectation to return to “normalcy” collapses.<sup>2</sup> In such cases where an anatomical part is lost, microvascular surgical reconstruction by free flaps is usually the treatment of choice. However, anatomic complexity, radiation therapy, possibility of recurrence, procedural complexity, medical condition or personal desires may exclude it as an option. An alternate treatment option in these cases would be prosthetic rehabilitation.<sup>1</sup>

The various extra oral defects encountered are-auricular defects, orbital/ocular defects, nasal defects, mid-facial, cranial and defects of hand/fingers. In clinical maxillofacial prosthodontic practice, impression making is the primary or

the first and most important procedure. A good impression is invaluable in the fabrication of an aesthetic and functional prosthesis. Hence, there is a need to know the various impression techniques available and incorporate them in clinical practice for patient care. Hence, an overview of the same is presented.

## 2. Impression for Auricular Prosthesis Fabrication

An auricular defect can be caused by several conditions like trauma, congenital malformation, or surgical removal of a neoplasm.<sup>3</sup> The auricular defects maybe unilateral or bilateral. The unilateral defects involve obtaining impressions of both the defect side and unaffected ear. Several impression techniques have been advocated by different authors.

### 2.1. Reversible hydrocolloid – By Kenneth E Brown (1970)<sup>4</sup>

In this technique the patient needs to be placed on a dental chair in a near supine position, after which the head is then rotated so the defect is present on a horizontal plane.

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The area around the ear is then generously outlined with an indelible pencil, and coordinates of the vertical and horizontal axes of the ear are made on the patient's skin. These markings are then transferred with the impression on to the working cast. These coordinates are of value in obtaining the proper orientation over the defect while making a new ear form. The patient's skin is then boxed to the circumscribed outline with a collar of wax and a reversible hydrocolloid impression is made by gently painting the material over the defect site. The impression material is then allowed to set and is carefully removed and inspected for accuracy and a working cast is poured.

### 2.2. Irreversible hydrocolloid-alternate technique-By Mathews MF (2000)<sup>5</sup>

In this technique, using the unaffected ear as a guide, reference lines are scribed around the defect area. A face-bow or custom-made orientation caliper can be used in transferring the vertical and horizontal axes of the unaffected ear to the restorative site with a skin marker. These lines will be transferred to the impression. Petroleum jelly or other lubricants are then applied to the hair and surrounding area and the external auditory meatus is blocked with a cotton pellet or small sponge. A rigid impression tray (plastic tub with the bottom removed (Reprosil Putty container; Dentsply International Inc, Milford, DE) or a piece of polyvinyl chloride (PVC) tube with 2 to 3 strips of utility rope wax around one end is used to box the impression site to achieve a seal without distorting the area. An adhesive is then applied and irreversible hydrocolloid impression material is then used in a very fluid consistency. A 60-mL disposable syringe is loaded with the impression material and then injected under the helix, providing support with a strip of gauze covered with the mix. Material is then injected into the internal contours of the ear and the impression is completed. After the irreversible hydrocolloid has set, it is removed using a slight twist. (twist clockwise on the right ear, counterclockwise on the left). The impression is then boxed and poured.

### 2.3. Implant retained auricular prosthesis -John F. Wolfaardt Philip (1996)<sup>6</sup>

In this technique a preliminary impression is made with impression copings incorporated in it, followed by which a relative bar and clip retained resin substructure is fabricated and is placed 1-3 mm away from the skin. Autopolymerising resin custom tray is then fabricated and is indexed to the resin substructure. This provides a clear visualization of retentive bar through the resin substructure through a window in it. The point of maximum skin depression is determined by assessing the movement of condyle of mandible under preauricular skin and head movement and

impression is made in these areas. The desired position of the prosthesis is then marked on the skin and a disposable syringe loaded with uncatalyzed silicone putty is then used to place the material around the margin of acrylic resin substructure to obtain a seal and continuous skin contact. The tray is then painted with an adhesive and loaded with polyether impression material and placed on the substructure and seated to engage the indices. The relationship of retentive bar can be verified by viewing the acrylic resin substructure through cutout in the tray. The impression is recovered and area of soft tissues with no tissue contact are identified and trimmed with a bur. A stainless steel wire of diameter that matches the retentive bar is introduced into the clips in the resin substructure. The impression is boxed and poured.

### 2.4. Implant impression technique – by Bergstrom (1993)<sup>7</sup>

In this technique the first step is to reproduce the detailed anatomic information about the defect area and precise positions of the abutments. Impression copings with long guide pins are then attached to the percutaneous abutments, and a thin layer low viscosity alginate is applied around the copings and over the area where the prosthesis will be fabricated. It is important not to cover the impression copings with alginate. Pieces of gauze are then placed on the surface of alginate, (Figure 1). When the alginate has set, a layer of fast set plaster is poured over the alginate.(Figure 2) The plaster secures impression copings in position and also stabilizes the alginate impression material. When plaster setting is completed, the guide pins are unscrewed and the impression is removed. Abutment replicas are connected to the impression copings, and the impression is cast in dental stone.

Cheng C. Ansgar et al. 1998,<sup>8</sup> described a method of fabricating implant retained auricular prosthesis with the use of thermoformed shell as a guide to ensure proper spatial relationship among the implant tissue bar, retentive elements and external contour of the auricular prosthesis.

Russell Wang, 1999<sup>9</sup> stated that step-wise procedures to confirm locations of craniofacial auricular implants using CT scan provide a better prognosis for the prosthetic treatment of auricular defects.

### 2.5. Functional impression- By Jain A(2016)<sup>10</sup>

In this technique the initial impression is made with alginate followed by which a cast is poured and then a clip retained acrylic substructure is fabricated with orientation groove and adapted along with the wax spacer over the diagnostic cast and custom tray is fabricated using autopolymerizing acrylic resin. The acrylic substructure is placed over the bar and functional impression is made by asking the patient to depress the mandible and move right and left



**Fig. 1:** Impression material with gauze



**Fig. 2:** Plaster

using polyvinylsiloxane light body elastomeric impression material. The impression obtained is evaluated for accuracy and then poured.

### 3. Impressions for Orbital Prosthesis Fabrication

Eyes are generally the first features of the face to be noticed, playing a significant role in our daily lives.<sup>11</sup> The loss of an eye can be due to a congenital defect, trauma, or a tumor. The most common orbital tumor being pseudotumor

inflammatorius (14.75% of patients). The other tumors that occur are cavernous hemangiomas, and meningiomas.<sup>12</sup>

Depending on the severity of the situation, there are 3 types of surgical management: Evisceration– Removal of the contents of the globe, but leaving the sclera and sometimes the cornea in place. The extra-ocular muscles are left intact, so good mobility of the prosthesis is usually possible, Enucleation- Removal of the eyeball itself, and exenteration- removal of the entire contents of the orbit, including the extraocular muscles.<sup>13</sup> The orbital prosthesis restores the eyeball, eyelids and may include the eyebrow. The ocular prosthesis replaces only the eyeball and does not replace missing eyelids or adjacent skin, mucosa or muscle. The orbital/ocular prosthesis can be given to a patient who has lost ocular structures through evisceration or enucleation.

#### 3.1. Impression -by Brown(1969)<sup>4</sup>

In this technique the patient is placed in a supine position and the entire face is encompassed with a wax collar to confine the impression material. The full face moulage facilitates more accurate three-dimensional alignment of the ocular globe in relation to the opposite eye. A sufficient amount of reversible hydrocolloid impression material is then painted onto the defect cooled to a tolerable temperature range of 110 to 115° F, to half the depth of the wax boxing. Bent paper clips are then placed in the cooling impression material for retention of the impression reinforcement, followed by quick setting plaster over the congealed impression material to form the reinforcement. The impression is then examined for any defects and cast is poured.

#### 3.2. Impression –by LEVY et al. (1980)<sup>14</sup>

In this technique the impression for the facial moulage is made with a thin mixture of alginate (irreversible hydrocolloid.) Open gauze pads are placed on the hydrocolloid impression and aids in retention of the plaster of Paris pour. The patient should be in an upright posture during this procedure to reduce the effects that gravity and the weight of the impression may have on the facial tissues.

#### 3.3. Beumer's technique (1979)-<sup>15</sup>

In this technique a thin layer of polysulfide impression material is applied to the defect area, followed by application of an unfolded gauze to the surface of the polysulfide before it polymerises. The impression and gauze are coated with a polysulfide adhesive followed by which a thin layer of plaster is then applied over the gauze with a brush and then several layers of quick set plaster.

### 3.4. Multiple tray technique for implant-retained orbital prostheses –by Thomas S<sup>16</sup>

In this technique after exposure of the implants and placement of healing cuffs, an irreversible hydrocolloid impression of the defect is made and cast is poured. On the preliminary cast, relief wax is placed over the duplicated implant healing cuffs to allow adequate space for impression material. The acrylic resin custom trays are then fabricated by making two trays triangular in shape and separated from each other to separate the defect into superior and inferior parts. A third middle tray over the other trays are made and positioned on the cast. The external matrix (fourth) tray is made by lubricating the external surfaces of the three internal trays on the preliminary cast and to form the matrix over the internal trays. When set, the external matrix tray is removed and perforated with a No. 8 round bur to enhance mechanical retention of the impression material. The tray is removed and polished. Appropriate abutments are placed on the implants and fit of the trays for adaptation to the defect is checked. The hair is then lubricated with a petroleum based lubricant. The implant transfer components is then placed in position and the tray is painted with an adhesive and allowed to dry. The inferior impression is then made by syringing impression material around the implant transfer parts, in the inferior part of the orbit, and in the tray. The excess material is then removed. The external aspect of the inferior impression is then lubricated with petroleum jelly. The superior impression is made in the same manner. If a middle tray is used, the clearance for the tray is checked. The tray is adjusted and an impression is made with sufficient impression material to allow joining of all impressions without locking one tray to the other. The external matrix tray is then adapted over the impressions to assess fit, painted with adhesive and allow to dry. With the impression material at each end, the external matrix tray is seated over the impression trays and allowed to set. The impressions is dissembled in a reverse order. The appropriate implant transfer analogs are then placed in the impressions and the impressions are reassembled using sticky wax to secure them together. The impression is then poured and cast is obtained.

## 4. Impressions for Ocular Prosthesis Fabrication

Ocular maxillofacial prosthesis artificially replaces a missing eye lost as a result of trauma, congenital absence or surgery; the prosthesis does not replace missing eyelids or adjacent skin, mucosa or muscle.<sup>17</sup> Various ocular impression have been described in the literature.

### 4.1. Stock tray impression-by Allen L et al. (1969)<sup>18,19</sup>

In this impression technique a stock ocular tray is placed into the defect to determine the proper orientation and fit without overextension. The tray is then removed and the

ophthalmic alginate impression material is loaded in the syringe and sufficient material is ejected to fill the concavity of the tray. The tray is reinserted and adequate material is injected to elevate the eyelid contours similar to the normal side. Once filled the patient is directed to move their eyes both up and down and once the impression sets, it is removed and examined for voids.

#### 4.1.1. Stock ocular tray modifications

1. Engelmier R.L.<sup>20</sup> advocated autoclavable custom made metal impression trays to improve infection control. Stock trays in ticonium which is a non precious,removable partial denture alloy (Ticonium Co, Albany, NY) and can be autoclaved for reuse is used with ophthalmic alginate(Ophthalmic Moldite).
2. Maloney<sup>21</sup> ocular tray consists of customized stock trays with 3 channels through the superior edge to prevent air entrapment and a raised ring around the stem prevents the eyelid from blocking the channels.
3. Sykes, Essop, and Veres<sup>22</sup> used modeling plastic impression compound as an ocular tray material, forming it around one half of a small rubber ball and placing a hollow tube through it. Ophthalmic alginate is then injected through the tube to make the impression.

### 4.2. External tray impression-by Taylor T.D(2000)<sup>1</sup>

In this technique alginate impression material is expressed into the defect using a disposable syringe. The patient is instructed to stare straight ahead as the material sets. Next a perforated acrylic resin tray is loaded and placed over the defect. The impression is first recovered from the lower, shallower sulcus, then rotated out of the deeper upper sulcus. The impression is boxed and poured in the dental stone upto the height of contour of the impression. A separating agent is then placed and the remainder of the impression is poured.

### 4.3. Impression with custom ocular tray –by Miller (1996)<sup>23</sup>

In this technique a solid suction rod is attached to the patient's existing prosthesis shell and then invested in an alginate mold. The alginate is allowed to set and the prosthesis, conformer, or wax is removed and replaced with clear acrylic resin. Perforations are made in the tray, and a tunnel is cut through which alginate impression material is injected.

### 4.4. Empirical technique- By Le Grand and Hughes (1990)<sup>24</sup>

In this technique a wax shell and aluminium iris button is taken to determine the anterior portion of the eye. The

aluminum button will make handling the shell easier. Once the desired shape is obtained, the button is removed and a (premade) plastic tube is attached. Sticky wax may be used to adhere the tube for extra strength. The tube will then be attached to a syringe and enable alginate to flow into the tray/socket. Once the alginate is set, a two-piece stone mold is made around the impression and shell. Speed and efficiency are two advantages in using this technique.

## 5. Impressions for Nasal Prosthesis Rehabilitation

A nasal prosthesis re-establishes esthetic form and anatomic contours, more effectively than by surgical reconstruction as the nose is a relatively immobile structure.<sup>25</sup> Mostly elastic impression materials that possess good flow properties are suitable for this task. Block the nasal passage with gauze to prevent entry of impression material.

### 5.1. Method at UCLA –by Beumer (1979)<sup>26</sup>

In this technique a thin layer of light body rubber base is applied to the defect area followed by a layer of gauze to the rubber base as the material begins to polymerize. Succeeding layers of quick setting plaster are then applied to the polysulfide to provide support for the elastic material. The initial layer must be thinned and partially set before succeeding layers of plaster are added.

### 5.2. Customized impression technique-by Shetty S (2018)<sup>27</sup>

In this technique petroleum jelly is applied to the patient's eyebrows and eyelashes and moist gauze is packed to prevent the flow of material into the undesired areas of the defect. An impression of the defect area is then made using irreversible hydrocolloid impression material (Tropicalgin, Zhermack, Italy). Paper clips are then attached to the surface of the impression material on the face, and dental plaster is applied over it so as to provide a rigid support for the impression. This impression is then carefully removed and poured using Type III dental stone to obtain a cast. A custom acrylic tray is then fabricated over this cast so as to achieve a functional impression of the tissues. For this Polyether (monophase) (Impregum, 3M ESPE, USA) impression material is then carried on the custom tray and the impression is made by asking the patient to do various facial movements, impression is retrieved and then poured using Type III dental stone to obtain a final cast

### 5.3. Implant-retained nasal prosthesis- by Guttal S<sup>28</sup>

In this technique after stage two surgery the nasal defect is packed with moist gauze to prevent the flow of the impression material into the nasal cavity. Care is taken not to distort the nasal tissues while packing the gauze. Impression posts are then connected to the implants and an impression

is made using medium-body vinylpolysiloxane impression material (Aquasil, Dentsply, Caulk, Milford, DE) in a custom tray (DPI RR, Mumbai, India). The impression posts are then unthreaded and connected to the laboratory analogs. The master cast is then made with dental stone

## 6. Impressions for Midfacial Prosthesis Rehabilitation

Midfacial defects are confined to the middle third of the face in the horizontal plane and that communicate with intra-oral maxillary defects. These defects can be classified as those in the midline and lateral.<sup>29</sup> Midline midfacial defects include complete or partial involvement of the nose and/or upper lip and communication with an intra-oral maxillary defect. Lateral midfacial defects include complete or partial involvement of the cheek and orbital contents, and communication with an intra-oral maxillary defects.

The defects in this region may result due to certain disease, pathological changes, radiation, burns, trauma or surgical intervention. The impression techniques include the following:-

### 6.1. Impression technique by Metz (1964)<sup>30</sup>

This technique describes an impression procedure for maxillofacial rehabilitation with facial, nasal and palatal defects. A gauze saturated with petroleum jelly is packed into the nasal cavity before the maxillary impression is made. The impression is then taken with an irreversible hydrocolloid material and casts is poured in dental stone and a denture is fabricated. Followed by this a facial moulage impression is taken. Eyebrows and exposed hair are lubricated with petroleum jelly. The Negacoll hydrocolloid is thoroughly heated in a double boiler until it becomes creamy and smooth and then brushed on with quick strokes, each slightly overlapping the preceding strokes. The entire face is then covered to a depth of half to one and half inch. Plaster matrix is then added to a thickness of half inch and gauze is embedded to add strength before it sets. The moulage is then removed and allowed to harden.

### 6.2. Impression technique by Victor Matacon et al (1968)<sup>31</sup>

This a technique for intranasal prosthesis. The patient is tipped back in the dental chair and part of the upper lip and external nose is then boxed with wax to confine the impression material. Alginate impression material is mixed and poured into the boxed area. In order to avoid trapping of air a small amount of the impression material is placed into the defect, before pouring the bulk of the material into the boxed area. Paper clips or gauze are then embedded in the soft irreversible hydrocolloid and the impressions material is allowed to set. A plaster backing is poured over the clips to prevent distortion and tearing of the impression, whilst removing.

## 7. Impressions for Cranial Defect

Defects involving the cranial vault could be a result of congenital deformities, trauma, decompressive craniectomies, and/or loss of bone flap due to infection.<sup>32,33</sup> Apart from the patient's physical appearance, a large surface of the brain remains unprotected. Patients with cranial defects often present with neurological symptoms headaches, dizziness, irritability, epilepsy, discomfort, and psychiatric symptoms which are known to improve with rehabilitation.

### 7.1. Impression technique-by Kharade P (2016)<sup>34</sup>

Proper examination of the cranial defect needs to be done first., following which an impression of the cranial defect is made with irreversible hydrocolloid (Jeltrate Type II; Dentsply Caulk) supported by dental plaster (Kaldent; Kalabhai). The impression is poured in a layered manner to avoid distorting the irreversible hydrocolloid and fabricate the moulage.

## 8. Impressions for Hand & Fingers

Finger and partial-finger amputations are frequently the most encountered forms of partial-hand losses. The most common causes of these amputations are traumatic injuries- such as frost bite, gun shot, burns, workers having a profession of agriculture, fishing, carpentry, congenital absences or malformations that present with clinical challenges. Any of the fingers may be affected in whole or in part and prosthetic restoration is often difficult. This is particularly true when multiple fingers are involved

Loss of finger produces significant esthetic and functional deficiencies. Common methods to replace the loss of finger are endoprosthesis (implants) and exoprosthesis (silicon prosthesis, acrylic prosthesis, prosthesis using attachments, and magnets.) Passing through various materials, the acceptance rate has been much higher when an individually sculpted custom restoration using silicone elastomer.<sup>35,36</sup>

### 8.1. Impression technique-by C.D Clarke (1945)<sup>37</sup>

In this technique a seamless hand mould is made for the prosthetic hand fabrication by filling a bag with agar. The hand and arm are inserted and the bag is soaked in ice water to hasten the setting of the agar. This is a lengthy process.

### 8.2. Impression technique- by J. Pillet (1983)<sup>38</sup>

In this technique plaster of Paris is used as a two part mould. This again is a lengthy technique and causes a seam on the model.

### 8.3. Defect impression

In this technique the hand is greased very lightly in any hair bearing areas followed by which a cardboard box or 2 litre plastic lemonade bottle is used to contain the impression. The patient is made to stand in a relaxed position with the arm held loosely at the side. The box is then positioned, to check for access. Irreversible hydrocolloid duplicating material is mixed and then painted all over the impression area. The hand is then positioned in the box, which is filled with a further mix of irreversible hydrocolloid, which in turn is left to set (approximately 10 minutes). When set, the hand is then removed by gently flexing the fingers and introducing a small amount of water, to break the suction, and withdrawing slowly and the impression is then poured. This same technique can be used for finger impressions

### 8.4. Impression technique for amputated Finger -by Garg M (2016)<sup>39</sup>

In this technique a thin layer of petroleum jelly is first applied to the patient's hand prior making an impression. Then a wide plastic container is selected according to the size of the palm and impressions of affected hand is made with irreversible hydrocolloid impression material by asking the patient to place his hand into the wide container. The impression is then poured with dental stone to create a positive replica of the amputated finger and associated structures.

### 8.5. Modified impression technique -by Tripathi S (2011)<sup>40</sup>

This technique requires an impression cap for carrying and supporting the impression material. An impression cap is used to make the impression with addition silicone impression material (Express, 3M ESPE; St. Paul, MN) and then the cast is poured. For the wax pattern of the missing part, an alginate impression of the same fingers of the other hand is then made in a slightly flexed position for duplicating the natural relaxed posture of the finger. For retention and also for an easy route for the alginate material a larger impression cap is used, in which vent holes are made

## 9. Impression for Toe and Foot Prosthesis

Amputation of entire or part of a limb may be due to various causes like systemic or vascular disease, infection, local injury or trauma.<sup>41</sup> Partially amputated lower limbs present a variety of unique clinical and prosthetic challenges, because of distinctly different amputation levels of the lower limb.

### 9.1. Impression Technique-by Pradeep C (2016)<sup>42</sup>

In this technique the area is cleaned using aseptic technique before making the impression. The impression



is made using irreversible hydrocolloid. The irreversible hydrocolloid is mixed as per manufactures instructions and painted on to the surface of one foot at a time. The irreversible hydrocolloid impression is then covered by surgical gauze. To reinforce the whole assembly it is then covered with a layer of dental plaster. After the dental plaster had completely set, the impression is removed using slow rocking movements. Dental stone is poured into impression and master cast is obtained free of voids. The impression of the unaffected foot serves as a mould to depict the morphology and aid in the fabrication of the wax pattern.

## 10. Modern Trends

Until the recent past, conventional impression materials such as irreversible hydrocolloid or silicones and techniques have been used to fabricate maxillofacial prostheses and extra-oral radiation devices.<sup>43</sup> The common problems related with conventional impressions include patient discomfort and distortion of the facial soft tissues.<sup>44</sup> The data can now be obtained with the recent advances like :-

Three-dimensional anatomic data (3-D facial measurements) using scanning techniques like computerized tomography, magnetic resonance imaging,<sup>45</sup> 3-D optical scanning, generation of a 3-D Computer Model (Blue-print)<sup>46</sup> and manufacturing a physical prototype by computer numerically controlled (CNC) milling and Rapid prototyping.<sup>44</sup>

## 11. Conclusion

Maxillofacial prosthetic restoration brings about responses of the whole person. These can be measured indirectly through the changes evoked in the self-image and in the strength of positive optimism. Ultimately, the maxillofacial prostheses restore several types of orofacial defects as well as improve the patient's quality of life. This is an ancient treatment modality that has developed over centuries. The current situation is promising, and there are positive expectations for the future.

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None.

## 13. Conflict of Interest

None.

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