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REVIEW ARTICLE

MAXILLOFACIAL PROSTHETICS PART-1: A REVIEW.

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Abstract

Maxillofacial disfigurement can be congenital, developmental, traumatic or because of ablative surgery. Such defects compromise appearance, function and render an individual, incapable of leading a relatively normal life and affect his\her psyche. As the patients quality of life is altered; social integration becomes difficult and the expectation to return to "normalcy" collapses. The prognosis for a successful treatment outcome is dependent upon making a correct diagnosis and anticipating issues beyond the realm of dentistry alone.
Microvascular surgical reconstruction by free flaps is usually the treatment of choice. However, radiation therapy, anatomic complexity, possibility of recurrence, and procedural complexity may exclude it as an option.
Prosthetic rehabilitation over the years has proven its mettle when it comes to such situations. It has considerable advantages; for example, observation for recurrence of disease, esthetic superiority, technical simplicity, and inexpensive care. Over decades several prostheses have been developed for this purpose, through this review our aim is to explain the salient features and the purpose of these prostheses.

Introduction:-

According to GPT 9, prosthesis can be defined as-
"An artificial replacement of part of the human anatomy restoring form, function, and esthetics" (2)
Patients who have suffered maxillofacial disfigurement exhibit a compromised appearance making them incapable of leading a normal life (3). Such patients experience a change in societal acceptance that greatly affects their psyche, and often their expectation to return to a normal life collapses (4, 5).

With advancements in plastic surgery, aesthetic corrections of such defects is possible, but, if surgery is contraindicated or the defect is so extensive that full closure is not possible or if the patient is unwilling to expose him/herself to surgery, maxillofacial prosthetics appear to be a viable option (6, 7, 8).

With recent advancements in prosthetic materials, coloring techniques and retentive mechanisms, a life like prosthesis can be given. The biggest impact of such prostheses is not only on the appearance but majorly on the psyche of the patient. The main objective is not only rehabilitation of the defect but also restoring confidence and improving quality of life of the patient (4, 9).

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The advantage of prosthetics is that it can be fabricated for any region of the face, the jaws or the cranium regardless of the extent of the defect, also the prosthesis allows for regular inspection and monitoring of the defect site thus, aiding in early identification of any recurrences (10, 11).

Objectives:-

The objectives of maxillofacial prosthetics includes the following important objectives-

a) Restoration of esthetics or cosmetic appearance of patient.
b) Restoration of function.
c) Protection of tissue.
d) Therapeutics or healing effect.
e) Psychological therapy.

When these objectives are met in a patient during the rehabilitation, then it can be concluded that the treatment is totally successful (12, 13).

Historical Perspective:-

Early records indicate that artificial eyes, ears, noses were found on Egyptian mummies. They were made from silver, gold, bronze and were often overlaid with organically – pigmented porcelain representing sclera and iris. Ivory, rock and quartz crystal eyes have been found among the ruins of Egyptian, Chinese, Aztec, lnca and even ancient Syrian civilizations (11, 12, 13, 14).

It was not until the French surgeon; **Ambrose Paré** (1517-1590) described the use of prostheses, as an alternative to surgical reconstruction and its short comings. Paré also wrote a detailed description of a silver nose which was tinted with oil paints, fitted with a moustache and secured with ligatures (12, 14, 15).

TychoBrache, a Danish astronomer of 16th century (1566) lost his nose and replaced it with an artificial nose made of silver and gold. He apparently made a wax pattern to fill the defect followed by casting it (12, 13).
The first artificial eyes made for the use of living humans were created from blown glass in Venice around 1579 (13).

In 1728, **Pierre Fauchard** designed a prosthesis supported with wings that were positioned by patient from the oral side of obturator and made use of floor of nose for retention (15).

In 1757, **Bourdet**suggested that silk ligatures attached to natural teeth could be used to support sheet metal to obturate the defect (15).

In 1820, **Delabarre** gave concept of wire connecting the obturator with laterally placed metal bonds that clamped on the teeth (15, 16).

In 1823, **Snell** first utilized rubber flaps attached to a gold hinge for retaining an obturator (15, 16).

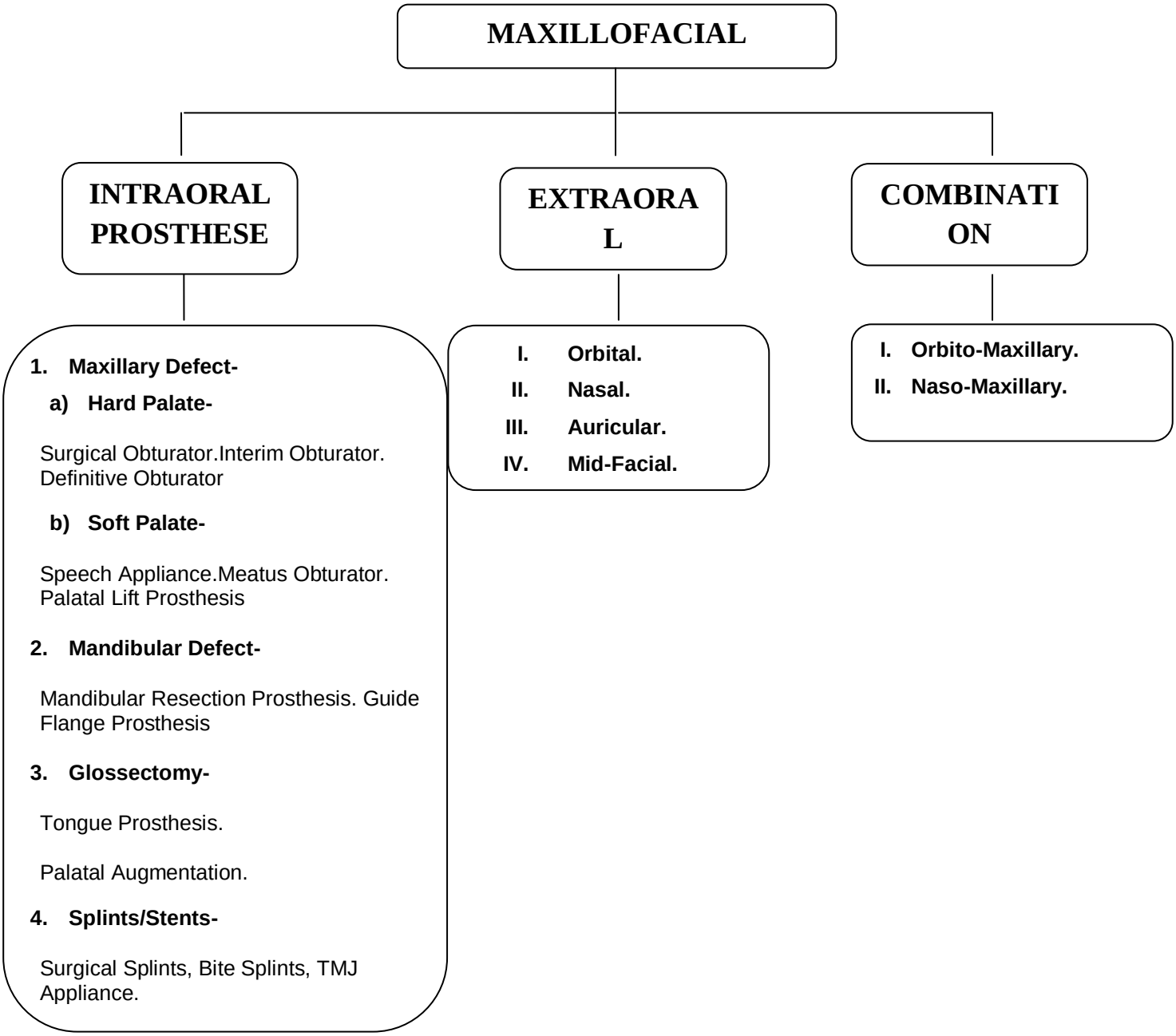
In 1832 a French soldier, **Alphonse Louis** came to be known as **"*Gunner with the silver mask*"** as left half of his mandible and much of his maxilla was destroyed, which was rehabilitated by **Saunders**, who described a prosthesis of silver which had mandibular teeth, a hinged front replacing the facial structures, and an internal collecting reservoir for the secreted saliva (12, 17).

In 1880, **Kingsley** described artificial appliances for restoration of congenital as well as acquired defects of palate, nose and orbit (13, 15, 16).

Tetamore in 1894 described 9 cases of nasal deformities that received prosthetic restorations that were made of a "very light plastic material" which approximated natural colour and was retained by bow spectacles (12).

In 1889, **Claude Martin** illustrated a variety of prosthetic replacements including porcelain nose prosthesis with an intraoral retention mechanism (12, 13).

Several maxillofacial prosthetics have been described in the literature so far, following is a classification of maxillofacial prosthetics-



Intraoral Prosthetics:-

Obturators:-

That component of a prosthesis that fits into and closes a defect within the oral cavity or other body defect (2). An obturator fulfills many functions-

1. It helps in feeding.
2. Helps in keeping surgical site clean.
3. Enhances healing of traumatized tissues.
4. Helps to reshape and reconstruct palatal contour.
5. Improves speech or makes speech possible.
6. Can be used to correct lip and cheek position.

7. Benefits morale of patients with maxillary defects.
8. Used to improve deglutition and mastication.
9. Reduces flow of nasal exudates into mouth.
10. Can be used as stent to hold dressings or packs.

Obturators can be for both congenital and acquired defects. For congenital defects simple plate type prosthesis to aid in feeding, or palatal lift prosthesis or an overlay or superimposed denture is fabricated (4, 9, 15, 17, 18, 19).

For acquired defects surgical, interim or definitive obturators are fabricated.

Obturators for Defects involving Hard Palate:-
They can be surgical, interim or definitive. These can be for either edentulous or dentulous patients.

Surgical obturator:-
A surgical obturator is one that is fabricated prior to resection of the maxilla, used during the surgery as a surgical guide and is attached to the maxilla after surgery to restore functions, aid in healing and to place surgical dressings or packs (20).

For a denture wearing edentulous patient the denture can serve as a surgical guide during the surgery and after surgery is attached to the remaining maxilla using ligature wires to retain surgical dressings (21).

If the patient is not a denture wearer then a clear acrylic baseplate is fabricated which is used as a stent at the time of surgery and as a surgical obturator after surgery.

In dentulous patients, the area to be resected is marked on the cast and the teeth in that region are removed and the palatal contour is restored. Wire clasps are fabricated on the remaining teeth and a baseplate is fabricated in clear acrylic to aid as a surgical stent (20, 22).

A surgical obturator itself serves as an interim obturator after making a few modifications like placement of acrylic teeth.

Definitive Obturator:-
After the interim obturator has been worn for 6-12 weeks the definitive obturator is fabricated.

For the dentulous patient it usually has a metal framework and cast clasps with hollow bulb orbturator. It can be a two piece or a single piece appliance (19, 23).

For the edentulous patient the obturator is fabricated along with the denture and it serves in retention, however, care should also be taken to record the limiting structures accurately during impression procedures (24, 25).

The obturator itself can either be fabricated in acrylic or silicone (25).

Obturators for Defects Involving Soft Palate:-
Speech Aid Prosthesis / Pharyngeal Obturator / Speech Bulb Prosthesis:-
Palatopharyngeal insufficiency is a condition where there is lack of effective closure between the soft palate and one or more of the pharyngeal walls during swallowing or speech sounds that require high intraoral pressure (18, 26).

This lack of closure may be due to four etiologic categories, namely, anatomic deficiency, myoneural deficiency, anatomic and myoneural deficiency, and neither anatomic nor myoneural deficiency (18, 26).

It is a congenital or acquired anatomical defect of the soft palate that makes the palatopharyngeal sphincter incomplete. Excessive nasal air flow, inadequate pressure effects the speech and nasal regurgitation is common during feeding (18, 26, 27).

Speech bulb prosthesis is an ideal choice for these defects. It is a removable prosthesis to restore an acquired or congenital defect of the soft palate with a portion extending into the pharynx to separate the oropharynx and nasopharynx during phonation and deglutition, thereby completing the palatopharyngeal sphincter (27, 28).

Meatus Obturator:-
The meatus obturator was first described by Schalit in 1946 (29).

It only provides static obturation and is not dependent on surrounding muscle activity to provide physiologic separation between the oral and nasal structures. It is not located in a region of muscle activity; therefore is not effective in refinement of speech, as seen with the pharyngeal obturators. For this reason the meatus obturator has not proved to be as effective as the horizontal obturator in cleft palate patients (30, 31, 32).

In cleft palate rehabilitation, obturation of the defect results in only partial improvement of speech. Intensive and continuing speech therapy is necessary to create a more normal speech. The patient must learn new patterns of speech production by retraining oral and pharyngeal musculature to function in concert with the obturator to produce desired sounds (18, 26).

Palatal Lift Prosthesis:-
T he palatal lift prosthesis (PLP) is used to improve soft palate dysfunction. The PLP places the soft palate in contact with the lateral and posterior pharyngeal walls to prevent nasal air escape during speech and prevent regurgitation of food and liquid during swallowing (33, 34, 35).

For dentulous patients, the palatal section of the PLP is securely retained by the teeth while the palatopharyngeal section physically raises the soft palate (35, 36).

In the edentulous patient, retention of a complete denture necessitates good border seal. Attachment of a fixed palatopharyngeal section will interrupt the border seal and cause dislodgment of the prosthesis. A PLP for the edentulous patient, therefore, must include a movable palatopharyngeal section (37).

Prostheses for Mandibular Continuity Defects:-
Mandibular Resection Prosthesis:-
Mandibular defects result from ablative surgery, trauma, osteoradionecrosis, and infections. These defects lead to significant facial deformity, functional disabilities, and psychological problems (3, 4). Management of such defects poses a challenge for the prosthodontist with respect to both control of the primary disease and post-treatment rehabilitation. Such patients were ignored because of unpredictable treatment outcomes (9, 11, 17).

Loss of mandibular continuity leads to rotation of lower occlusal plane inferiorly on the defect side. The suprahyoid muscles pull the residual mandible causing inferior displacement and rotation along fulcrum of the remaining condyle leading to an anterior open bite (38).

During rehabilitation the most difficult procedures are that of impression making and recording jaw relations, also special consideration to occlusion is given to achieve maximum stability (21, 38, 39).

Guide Flange Prosthesis:-
If mandibular continuity is not restored during surgical closure of wound, the remaining mandibular segment will retrude and deviate toward the surgical side at the vertical dimension of rest. When mouth is opened, the deviation increases, leading to an angular pathway of opening and closing. During mastication, the entire envelope of motion occurs on the surgical defect side (38, 40).

This mandibular deviation is mainly due to uncompensated influence of contralateral musculature particularly the internal pterygoid muscle and pull from the contraction of cicatricial tissue on resected side (40, 41).

Several modalities to return the mandible to optimum maxillo-mandibular relationship have been described, like, intermaxillary fixation, vacuum formed PVC splints, mandibular guidance prostheses and a widened maxillary occlusal table using a double row of teeth (38).

A mandibular guidance prosthesis can be defined as a maxillofacial prosthesis used to maintain a functional position for the jaws (maxilla and mandible), improve speech and deglutition following trauma and/or surgery to the mandible and/or adjacent structures. The main objective of using guidance prosthesis is to re-educate the mandibular muscles to re-establish an acceptable occlusal relationship (physiotherapeutic function) for residual hemi-mandible (40, 41, 42).

Prostheses for Total/Partial Glossectomy:-

Tongue Prosthesis:-

The tongue, particularly its posterior lateral aspect, is a common site for oral carcinomas. Frequently, the treatment involves surgical excision, radiation therapy, or both. In patients with extensive lesions, the resections may include the floor of the mouth and the bone of the mandible in addition to the tongue (4, 17).

With limited resections, where 50% or less of the tongue is removed, patients have little functional impairment. However, in patients with more extensive resection, impairment of mastication, deglutition, and speech may occur (4).

In such patients prosthetic restoration becomes a necessity and it also poses a challenge for the prosthodontist because of physiologic and functional reasons.

Major goals in prosthetic rehabilitation of the tongue are (43, 44)-

1. Reduce size of oral cavity which improves resonance and decreases pooling of saliva.
2. Direction of food bolus into oropharynx.
3. Protection of underlying mucosa.
4. Development of surface contact with surrounding structures during speech.
5. Improve appearance and psychosocial adjustment.

Palatal Augmentation Prosthesis:-

Patients with partial glossectomy suffer from two major problems, i.e.; speech and difficult deglutition; this is because in such cases the remaining tongue is attached to the floor of mouth, which leads to limited movement of the tongue (4, 43, 44).

The palatal augmentation prosthesis is characterized by a very low palate that allows the tongue (which has limited mobility) to come in contact during swallowing and speaking, thus allowing easy articulation of speech and trouble free swallowing (4, 43, 44).

Splints & Stents:-

Surgical & Bite Splints:-

Surgical splints are splints that that are initially used to guide the surgeon in operating a particular region of the jaw and then the same splint is used to support the operated area till complete healing, eg; cap splint used to fixate and stabilize mandibular fractures in children (9, 17, 45).

Bite splints serve the purpose of stabilizing the bite in a particular position that is most favorable for the existing dentition. These may also be used to serve a dual purpose of maintaining the bite along with stabilizing the operated jaw bone site, eg; in orthognathic surgeries where a severe class III situation is corrected by removing sections of bone bilaterally and securing the severed ends of the bone together by giving a bite splint which also helps the patient in adapting to the new bite (9, 17, 46).

TMJ Appliance:-

These are appliances that help in relieving TMJ trismus and increase mouth opening. These appliances are basically "jaw excercisers" that have a physiotherapeutic effect on the joint and associated muscles and ligaments. They function by taking over the job of depressor group of masticatory muscles and cause forceful jaw opening, at the same time it also strengthens masticatory muscles (47, 48).

Radiation Stents:-

Shielding stents are basically anti-radiation stents that protect areas other than the operated site from harmful gamma radiation (17).

Carrier stents are stents that help in carrying radiation to the operated site and thereby preventing exposure of healthy areas to radiation (17).
Positioning stents help in appropriate positioning of the source of radiation over the site to be irradiated; such stents can also be fabricated to aid in radiography of a particular area (17).

Extraoral Prostheses:-
The care of patients with extraoral head and neck malignant disease is not limited to the elimination of disease only. A comprehensive treatment plan for a patient requiring extraoral rehabilitation should be drawn up before surgery (6, 7, 8).

An extraoral prosthesis acts like a cosmetic bandage that camouflages a surgical defect not desirable for surgical reconstruction. An extraoral prosthesis may be considered for the following (8)-

1. Incomplete closure of large defects with grafted soft tissue.
2. Difficult surgical reconstruction of structures, (i.e., an eye, nose, or ear).
3. Patient's psychological or physical incapability of tolerating a multistage surgical reconstruction.
4. Surgical defects that need to be monitored for recurrent disease.
5. Temporary use during multistage surgical reconstruction.

Orbital Prosthesis-
There are various techniques used in fitting and fabricating artificial eyes. In the past, empirically fitting a stock eye was a popular method, and it is still in use today. This method involves modifying a stock shape by grinding and re-polishing the surface of the eye, and trial-and-error fitting the borders of the prosthesis into the socket (4, 49).

Ocular prostheses are fabricated in acrylic resin. Although the material is standard, some variations in technique exist, such as the use of a microwave oven for processing, length of processing times, and the methods of assembly of the component parts of the prosthesis (50, 51).

A properly fitted and acceptable custom ocular prosthesis has the following characteristics (51):
1. Retains the shape of the defect socket.
2. Prevents collapse or loss of shape of the lids.
3. Provides proper muscular action of the lids.
4. Prevents accumulation of fluid in the cavity.
5. Maintains palpebral opening similar to the natural eye.
6. Mimics the colouration and proportions of the natural eye.
7. Has a gaze similar to the natural eye.

Nasal Prosthesis:-
The human nose, because of its prominence and commanding role in establishing facial character, is a difficult structure to replace. Construction of a nose prosthesis supplying adequate function and esthetics requires both prosthodontic and artistic skills. Also with advancements in retentive mechanisms an artificial nose can be retained somewhat permanently (till prosthesis itself needs to be changed) and made to appear like a natural part of the body (4, 52, 53).

Auricular Prosthesis:-
Congenital deformities,tumours and trauma are the most common causes of a defect or loss of the auricle (54). Loss of part of the ear is much better treated by plastic surgery (54), but in cases with complete auricular loss, restoration with surgery becomes complicated, in such situations and artificial ear can be easily fabricated and retained to resemble a natural ear (4, 55, 56).

Mid-Facial Prosthesis:-
Acquired mid-facial defects often present with severe disfigurement and functional impairment. Large defects that result from cancer treatment rarely are rehabilitated by surgical reconstruction alone; they usually require a facial prosthesis to restore function and appearance. In addition, an intraoral prosthesis such as an obturator is often needed to restore speech and swallowing. Fabrication of an extraoral facial prosthesis challenges the artistic ability of the prosthodontist (4, 11, 57).

Retention of the prosthesis is also a difficult problem because of its size and weight; securing it in place can be a formidable task (4, 11, 58, 59).

Loss of the integrity of oral cavity results in difficulty in mastication, swallowing, control of saliva and speech production. These functional disabilities in combination with accompanying cosmetic disabilities, has a great psychological impact. Rehabilitation with prosthetic restoration helps in speech and swallowing to be restored to near normal level and control of saliva and mastication may be improved. The cosmetic appearance too improves (4, 11, 59).

In addition, since most patients had extensive disease prior to surgery, radiation therapy may have been used as an adjunct. In most patients, this precludes the possibility of surgical reconstruction.

Types of Mid-Facial Prosthesis-

1. Temporary Prosthesis.
2. Definitive Prosthesis.

Combination Of Intra &Extraoral Prostheses:-

Orbito-Maxillary &Naso-Maxillary Prostheses:-

Resection of nasal cavity in tumors leads to defects in nose, upper lip, and orbit with extension into oral cavity. The prognosis depends on the presence and condition of the teeth, amount and contour of the remaining hard palate, the functional status of lower lip, and the motivation and adaptability of the patient (57, 60).

The oral prosthesis is completed first. The oral prosthesis should be fabricated such that it restores most functions of speech, mastication, swallowing and esthetics. These prosthetics should also distribute forces as efficiently as possible (60, 61).

During impressions of the face variable degrees of tissue bed mobility are encountered. The movement of structures, such as the anterior border of ramus, corner of mouth, and lower lip, should be accounted for in the impression procedure. Impressions should be made with oral prosthesis positioned in the mouth (60, 61, 62).

The defect should be utilized as much as possible to facilitate stability and retention. The prosthetic upper lip must functionally engage the lower lip and, allow the lower lip to articulate with the maxillary anterior teeth (62).

The advantage is that, the oral prosthesis can be designed so that the movement created during swallowing and mastication are not transferred to the facial portion. Also, the forces generated by retention and stability in the facial portion can be directed to the defect area.

Conclusion:-

The rehabilitation of intraoral and extraoral defects is a challenging aspect of maxillofacial prosthodontics. It requires constant practice of the art to gain confidence and expertise. The goals of the surgeon and prosthetic specialist regarding rehabilitation of the patient are closely allied.

The maxillofacial prosthodontist should always try to provide the treatment to the fullest of his ability. Sophistication in the prosthetic reconstruction of structural and functional defects improves the final results, if carefully planned, unbiased rehabilitation regimens are established.

It is imperative that the prosthodontists involved either directly or indirectly in prosthetic rehabilitation to be aware of the situations discussed here, so that a more complete and successful service may be rendered to their patients.

CONFLICT OF INTREST- None

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