About the Book
This book is a concise description of Maxillofacial Prosthesis. It consists of illustrative pictures for each steps of the extensive procedures. It would be of great help for the practicing Dental Surgeons specially Prosthodontist. This book will definitely boost the confidence of the Dental surgeons.

Dr. Desh Deepak
is currently working as Senior Lecturer in Department of Prosthodontics and Crown & Bridge, Dr BR Ambedkar Dental College and Hospital, Patna, Bihar, India. He have completed his MDS from PMNM Dental College and Hospital, Bagalkot, Karnataka, India in 2018. He completed his graduation (BDS) in 2012 from Manipal College of Dental Sciences, Mangalore, India. He extensively trained in maxillofacial rehabilitation, Implant supported prosthesis and removable and fixed prosthesis.

Dr. Amar kumar
is currently working as senior resident at Dept. Of dentistry, ANMMCH, Gaya, Bihar since 2019. He obtained his master's in Oral and Maxillofacial surgery in 2017 after completing his graduation (BDS) in 2011, from Manipal academy of higher education (MAHE). He is a life member of Association of Oral and Maxillofacial Surgeon of India. He has been practicing the faculty of maxillofacial surgery as consultant since his MDS. He has also attended various certification for scientific writing and research.

Dr. Abhishek Gupta
is currently working as Assistant Professor and In charge of Department of Oral Medicine and Radiology, Chitwan Medical College, Chitwan, Nepal. He obtained his Master's in Dental Surgery, specialized in Oral Medicine and Radiology from Government Dental College and Research Institute, Bangalore, India in 2018. He completed his graduation (BDS) in 2012 from Manipal College of Dental Sciences, Manipal, India. He has been practicing as a Oral Physician and Maxillofacial Radiologist, as well as Subject specific academic lectures for Bachelor's of Dental Surgery and MBBS. He is a Life member of Indian Academy of Oral Medicine and Radiology, as well as Nepal Association of Dental Research. He have various certification for Scientific writing and research.

Dr. Surendra Kumar Acharya,
MDS from AIIMS New Delhi. First omfs surgeon in nepal trained in advanced trauma life support (ATLS) AHA ACLS BLS provider. Nepal medical council master trainer in medical emergency. Oral and Maxillofacial Surgeon in Nepal, who is extensively trained in Craniofacial Surgery, Microneurosurgery and advanced Implantology (all on four/zygomatic/pterygoid implant). As an Oral & Maxillofacial Surgeon, he is trained in diagnosis and treatment of a diverse range of injuries, diseases and faults in the Head, Neck, Face & Jaw area and the hard and the soft tissues of the oral & Maxillofacial region.

Dr. Kishore Kumar
currently working as consultant orthodontist in various dental clinics in Patna. He have completed his MDS in Orthodontics and dentofacial orthopaedics from Al-badar rural dental college and hospital, Gulbarga, Karnataka in 2018. Obtained his BDS degree from SDM college of dental sciences and hospital Dharwad, Karnataka in 2012. He is a life member of Indian orthodontic society.

WhiteFalcon Publishing
www.whitefalconpublishing.com

ISBN: 978-1-63640-277-2
9 781636 402772
₹350
BUSINESS

Maxillofacial Prosthesis

Dr. Desh Deepak

Maxillofacial Prosthesis

Dr. Desh Deepak

Maxillofacial Prosthesis

Dr. Desh Deepak, Dr. Amar Kumar, Dr. Abhishek Gupta,
Dr. Surendra Kumar Acharya and Dr. Kishore Kumar

White Falcon Publishing
www.whitefalconpublishing.com

Maxillofacial Prosthesis
Dr. Desh Deepak, Dr. Amar Kumar, Dr. Abhishek Gupta,
Dr. Surendra Kumar Acharya and Dr. Kishore Kumar

www.whitefalconpublishing.com

First Edition, 2021

Cover and Interior design by Dr. Desh Deepak, Dr. Amar Kumar,
Dr. Abhishek Gupta, Dr. Surendra Kumar Acharya
and Dr. Kishore Kumar

ISBN - 978-1-63640-277-2

C O N T E N T S

CHAPTER 1: INTRODUCTION By Dr. Desh Deepak

Following World War II, an era of specialization among health care professionals ensued. As a sub-specialty area of the recognized dental specialty prosthodontics, maxillofacial prosthetics has become an essential patient-care link between dentistry and surgery.[1]

Rehabilitation of patients with disabilities of head and neck secondary to acquired or congenital defects is a difficult task and so requires close interaction among a number of health science disciplines.[2] The prosthodontist serves as a full member of the rehabilitation team and ordinarily be involved in pretreatment planning as well as the construction of temporary or permanent post treatment appliances. The prosthodontist's functions may range from routine maintenance of oral health to the removal of teeth in areas planned for radiation to the construction of appliances in irradiated areas.[3] Having undergone some evolutionary change, the principles, concepts and practices applicable to prosthodontic treatment still constitute the fundamental basis for sound maxillofacial prosthetic therapy.[1]

The demand for the maxillofacial prosthetic devices for the rehabilitation of patients with congenital and acquired defects has intensified in recent years.[3] Despite remarkable advances in surgical management of oral and facial defects, many such defects cannot be satisfactorily repaired by plastic surgery alone. Further, increased life span of individuals and growing demand for health care services plays additional obligations on dental profession to provide trained maxillofacial prosthodontists. Many recent developments in polymer research and in the fabrication of appliances have permitted the maxillofacial prosthodontist to restore large numbers of such people to society.

Few areas in dentistry offer more challenges to the technical skills and ingenuity, than the successful rehabilitation of function and esthetics in the patient with gross anatomic defects and deformities of the head and neck regions.[3]

This book describes the general techniques and materials used in constructing maxillofacial prosthetic devices for special clinical situations. Both intraoral and extraoral prosthetic devices are discussed.

CHAPTER 2: REVIEW OF LITERATURE

By Dr. Desh Deepak

The earliest attempts at obturator construction are credited to Ambrose Pare, who, around 1530,described button shaped obturators made of metal and sponge. The search for better materials and improved means of prosthesis retention was advanced in 18th century by Fauchard, who, using metal created the prototype of maxillary major connector for the use in the replacement of natural teeth.[4]

Tycho Brahe, a Danish astronomer of the 16th century, lost his nose in a duel and replaced it with a artificial nose made of silver and gold. The London Medical Gazette of 1832 describes the case of the "Gunner with the Silver Mask," a French soldier whose face was seriously injured in battle. The left half of the mandible was carried away and the alveolar process was fractured, along with the teeth. A physician designed the prosthesis, which looked like a mask. This case demonstrated that metals could be used in prosthetic restorations about the face.[3]

In 1867, Suersen suggested fixed obturator using a wire loop posterior extension shaped by the use of warm gutta percha, which would be molded in the mouth by muscle trimming. This technique except for modifications facilitating the use of newer materials, had remained the basis for current practices.[5]

Tetamore in 1894 described and illustrated nine cases of nasal deformities that received prosthetic restorations. He stated that these artificial noses were made of very light plastic material that approximated the natural color. They were secured on the face by bow spectacles.[3]

Ackerman advocated the use of intermaxillary fixation or guidance protheses immediately post operatively. The prosthesis design used a "gate-hinge clasp" for maximum stability during function. This design is quite

similar to the current swing lock removable partial dentures. He felt that intermaxillary fixation decreased the mandibular deviation.[6]

Robinson and Rubright stressed the use of preoperative mounted casts on which a temporary acrylic resin mandibular guide flange prosthesis could be fabricated. The temporary acrylic resin guide flange was inserted on the 3rd postoperative day and used by the patient for 1 year. At the end of 1 year, patient was able to move the mandible into a functional relationship without assistance. The definitive partial denture was made of cast gold and the buccal guide flange in acrylic resin.[7]

When treating edentulous mandibular resection patients Swoope formed a palatal ramp to broaden the occlusal table and make it easier for the patient to obtain stabilizing occlusal contacts. The ramp was initially formed in wax as the patient attempted to move the mandible as far as possible towards the nondefect side. The patient supplied the force while the mandible was guided by the dentist.[8]

Schaaf described removable partial denture flange prosthesis for the patient with remaining natural teeth. In partially edentulous patients if the teeth are strong enough, mandibular cast removable partial denture flange prosthesis can be used to reduce mandibular deviation. With partially edentulous patients with weak teeth, or if deviation has been present for a long time, the dentist should record an occlusal relationship that allows freedom of lateral mandibular motion and a Monson curve type of occlusion may be indicated as a guide.[9]

Dr. Mohamed A. Aramany in 1978 classified post surgical maxillary defects into 6 categories based on the relationship of the defect to the remaining teeth and frequency of occurrence of the defect. This could be used to develop a series of basic obturator designs in particular situations.[10]

In 1979, Desjardins stated that many mandibular resection patients need a guide prosthesis to assist in muscle retraining for mandibular movement. In dentulous patients, a maxillary palatal inclined plane, palatal to the posterior teeth

on the nondefect side was mentioned as a possible training device. Inclined planes are not used in edentulous patients because denture stability may be compromised. Therefore, retraining of mandibular deviation in the edentulous patient may not be possible. For dentulous patients who can achieve proper occlusal relationships but cannot hold that position for adequate mastication, a lateral guide flange may be used. The prosthesis is designed to maintain a vertical chewing stroke with little or no lateral movement.[11]

Vergo and Chapman proposed the use of silicon obturator prosthesis to enhance retention and oronasal seperation. They recommended the use of extension placed on the nasal side of the soft palate and as an obturator segment to provide retention and oronasal seperation.[12]

Mc Kinstry et al studied the speech considerations in prosthodontic rehabilitation of the glossectomy patient. They concluded that the amount and portion of tongue resected is directly correlated with speech intelligibility. The loss of the tip of the tongue is more critical to the intelligibility than hemiglossectomy. Partial glossectomy speakers can often use the residual tongue stump to perform adaptive movements that approximate the normal movements and should be treated as an articulation problem.[13]

McKinstry and Aramany discussed the prosthodontic considerations in the management of surgically compromised cleft palate patients. They concluded that surgical redivision of soft palate with removal of the levator veli palatini muscles as an aid to construction of a pharyngeal obturator is contraindicated. The surgical redivision with removal of muscles prevents subsequent surgical procedures and commits the patient to a prosthesis for life.[14]

Watson and Gray assessed effective obturation. They said that the use of lung function tests and sequential radiography appear to be suitable complementary methods of contrasting the effectiveness of obturator prosthesis. Effective obturation produced the sufficient separation of the oral cavity from the nasal cavity to permit efficient swallowing and intelligible speech.[15]

Phankosol and Martin described a technique for the fabrication of a removable lid for the hollow obturator. This type of obturator has benefits of both closed and open systems. Hollowing the obturator reduces the weight of the prosthesis.[16]

The use of ceramic pigments as applied to maxillofacial prostheses was evaluated by Seluk et al. Samples of unsintered versus sintered pigmented porcelain were mixed into Silastic 44210 and evaluated with respect to color stability after accelerated aging. There was clear demonstration that sintered pigments were more color stable than unsintered pigments.[17]

Schwartzman, Caputo, Dumer said that reconstruction after surgical resection of the maxillae and the paranasal sinuses is difficult. In addition to the intermittent forces encountered during function the prosthesis is subjected to the constant force of gravity. Their investigation photoelastically studied the gravity-induced stresses transmitted to the remaining oral structures by various obturator prosthesis framework designs. Frameworks, which used I-bar and circumferential retainers with buccal retention, were most kind to the remaining structures. These same designs with lingual retention were most severe, while the swing lock and light wire retainers were intermediate in generating stress.[18]

Leonard and Gillis made speech recordings for subjects with and without their prostheses. Findings indicated that all subjects demonstrated improvements on speech measures with prostheses. They suggested that prosthetic approaches to speech rehabilitation in patients who have undergone ablative procedures are effective.[19]

Minsley, Warren and Hairfield determined the effect of a speech aid prosthesis on resting breathing. Nasal cross sectional area was measured during inspiration and expiration in cleft patients. The results revealed the presence of speech aid prosthesis decreased the cross sectional region of nasal airway. They

suggest that the design of these prostheses should account for the breathing requirements as well as for speech.[20]

Schmaman and Carr in 1992 presented a foam impression technique for maxiallary defects which is used to overcome the problems of withdrawal of maxillectomy defect impressions with or without limited space as the result of trismus.[21]

The possibility of achieving osseointegration around an orbital defect was not as good as in the mastoid process. Higher success rates were reported for implants placed in the mastoid region in comparison to the orbital region, especially after radiation. The same observation was made by evaluating osseointegrated implants in the restorative treatment of auricular and orbital defects over a 5-year period. The total success rate for survived implants was 95.6% in the auricular defects and only 67.2% in the orbital defects.[22]

Gary and Donovan suggested various retentive designs for facial prostheses. The use of bone anchored implants to retain a facial prosthesis can minimize retention problems and provide a psychologically acceptable prosthesis. The retentive element is designed so that the retentive bar is comfortable, conveniently hygienic and without compromising the correct contours of the anatomic part being replaced.[23]

Ninety – eight patients who received prosthodontic treatment for maxillofacial defects were examined clinically, by means of questionnaires and by registration of chewing efficiency and occlusal force. Although 30% of the patients stated that they could chew soft food, and one third could not chew the test food (almonds), only 14% said they had a poor chewing ability. The mean occlusal force was small (80N) but the individual variation was great (median 49 N, maximum 327N). Despite major defects and poor functional test results, most patients were remarkably well – adapted to their situation and to maxillofacial prosthodontic rehabilitation. Severe signs and symptoms of temperomandibular disorders were rare.[24]

Johnston et al established a translucency parameter by collecting optical scattering and absorption coefficients and applying the Kubelka – Munk reflectance theory. The actual procedure involved measuring the colored medical – grade silicone sample, which was placed on an ideal dark backing and an ideal white backing. Significant differences were noted among the translucency parameters of the colorants.[25]

One study questioned the ability of palatal lift prostheses to stimulate the neuromuscular activity of the velopharynx in evaluating 25 patients who underwent placement of palatal lift prosthesis for velopharyngeal dysfunction. Nonendoscopic evaluations were audio – videotaped before and after the prosthetic treatment, and the tapes were rated according to three speech pathologists experienced in assessment of patients with velopharyngeal dysfunctions. Results of this study neither supported the concept that palatal lift prostheses alter the neuromuscular patterning of the velopharynx nor provided objective documentation of the feasibility of prosthetic reduction for weaning.[26]

Zaki,Ketzan and Janecka modified an ear piece face bow to verify the position of strategic landmarks during reconstruction of an orbital prosthesis. The modification was performed by the incorporation of two symmetrically placed anterior reference pointers. The face bow can be used in the operating room during surgical reconstruction and for facial prosthetic restoration. It is simple to use versatile and it can be sterilized.[27]

The clinical successes of light – cured obturators were evaluated in ten maxillectomy patients. All ten patients had previously worn conventional heat cured hollow bulb acrylic obturators and were currently rehabilitated with light – cured obturators. The obturators were assessed on their performance for weight, retention, speech, eating and comfort. The authors concluded that patients found light – cured obturators to have a more acceptable clinical performance than conventional acrylic obturators primarily because of a reduction in appliance weight.[28]

One of the difficult aspects of sculpting is constructing mirror image prosthesis. Lemon et al described a simple technique for producing a mirror image of a cast for sculpting an auricular prosthesis. This method duplicates on the surgical side of the face, the morphology of a patient's remaining ear and its relationship to the surrounding tissues. A transparency copy of the contralateral ear is used to sculpt the auricular prosthesis.[29]

The custom made ocular prosthesis contributes to enhanced tissue health of the anophthalmic socket. An acrylic resin ocular prosthesis may be modified for this purpose. Ow and Amrith described the application of tissue conditioner as an impression medium for prosthetic modification. This material exhibits favorable tissue compatibility, adhesion to acrylic resin, and detailed surface registration.[30]

Russell R Wang gives a clinical report where a sectional magnet retained obturator was used to restore the speech, deglutition and midfacial contour for a patient with bilateral total maxillectomy. This sectional prosthesis also eliminated the long-term use of a nasogastric tube.[31]

Russell R Wang described an easy time saving procedure that uses visible light activated denture base material as a relined material to close an open type interim obturator. This procedure can be successfully for both late stage interim obturators and / or for correcting leakage problems for patients who were definitive obturators. This provides innovative methods denture relining and easy fabrication of maxillofacial prothesis.[32]

Zaki and Myers described indirect obturation of large nasal septal defects by the use of heat processed acrylic resin intranasal stent. Large nasal defects cannot be closed by hard acrylic resin obturators because of access problems. However it can be achieved by the construction of nasal stent that fits into one of the nasal cavities. The medial of the stent indirectly allows for the partition of two nasal cavities. The stent is rendered patent to allow for comfortable breathing. These nasal stents indirectly separate two nasal cavities and effective obturation is achieved.[33]

The placement of extraoral implants is important for improving a patient's quality of life because conventional prostheses may lack adequate retention and stability, which diminishes the patient's confidence that the prosthesis will remain in place during routine activities. One study assessed the role of extraoral implants in improvement in quality of life by a questionnaire. Five patients with acquired midface defects were treated with 19 titanium endosseous root- form implants to provide retention and stability for prostheses. Patients responded to a questionnaire rating overall use, effectiveness, and satisfaction of their prosthesis before and after the use of implants. Analysis of the questionnaire indicated an improvement in the quality of life for the patients with an implant-retained prosthesis.[34]

Speech intelligibility after maxillectomy was analyzed in 54 patients with and without obturator prosthesis. With obturator prosthesis the mean speech intelligibility score of 84% was twice as high than without an obturator prosthesis, which resulted in a mean speech intelligibility score of only 35%. The resection of the anterior portion of the soft palate was one of the factors that influenced the speech intelligibility score of a prosthesis.[35]

Cheng et al presented the methods to overcome problem of severe lingual undercuts in patients who have undergone a mandibulectomy procedure. These methods can also be used for fabricating other prostheses when engagement of bilateral undercuts is desired to enhance the functional outcome. The area immediately below the hinge assembly should be relieved from the supporting soft tissue.[36]

The effect of palatal lift prosthesis with pharyngeal bulb on the levator veli palatine muscle activity during blowing was evaluated by electromyography on eight patients. Electromyography of the levator veli palatine muscle was recorded with a speech appliance in place and then with the speech appliance removed as the subject blew through a tube at three different effort levels. The electromyographic levator activity changed in relation to oral air pressure with either speech appliance in place for all

subjects regardless of their speech appliance types. The authors concluded that the effect of a speech appliance to correct velopharyngeal incompetence might consist not only of mechanical obturation of the velopharynx but also of alteration of velopharyngeal function to become similar to normal speakers. The study also summarized the likelihood that the velopharyngeal system could be well regulated so as to exhibit a consistent out come of velopharyngeal function.[37]

Haug et al have reported that dry earth pigments, kaolin, and rayon flocking acted as a solid filler without bonding to the silicone, and artist's oils and liquid cosmetics acted as a liquid base without bonding to the silicone matrix. The addition of colorants could have a stabilizing effect on the elastomer color when it is exposed to weathering.[38]

Neurologists do not frequently request the use of palatal lift prostheses and palatal augmentation prostheses for dysarthria in patients who suffer from amylotrophic lateral sclerosis, a progressive adult onset neurodegenerative disorder. A retrospective study based on 25 patients who suffered from this disease assessed the efficacy of a palatal lift and augmentation prosthesis on improving speech function and intelligibility through chart reviews, phone interviews, and office interviews. The reported results were encouraging: 84% of the patients treated with a palatal lift prosthesis demonstrated improvement in their dysarthia, specifically in reduction of hypernasality; 76% of the patients benefited at least moderately for 6 months. Of the 10 patients treated with a combination palatal lift and augmentation prosthesis, 6 demonstrated improvement in articulation. Most patients indicated that it was easier to speak with less effort involved when wearing the prosthesis. Consequently, the authors recommended the use of a palatal lift and augmentation prosthesis in amylotrophic lateral sclerosis patients with dysarthria.[39]

Sykes, Wolfaardt and Sukha said that patients with complete avulsion of the palate might require extensive surgical and prosthodontic rehabilitation. The prosthesis should replace not only the missing teeth but

also lost soft tissues and bone, including the hard palate, residual alveolar ridges and in some situations, the soft palate. When surgical reconstruction of the maxilla is delayed, contraindicated, declined by the patient, or not possible, prosthetic obturation remains the treatment of choice.[40]

Shenoy, Shetty and Alva recommended a pinhole nasal prosthesis as an effective alternative form of treatment for atrophic rhinitis, which is a nasal mucosal disease characterized by foul smelling discharge crests and enlargement of the nasal cavity. This prosthesis reduces the air entry through the nose thereby producing nasal cilia and inducing reversibility of the nasal mucosa. It is easy to make, economical, well tolerated by the patients and an noninvasive procedure.[41]

Penn, Grossmann, Shifman described a technique that enables adaptation of surgical obturator to accommodate the anterior teeth that may or may not be resected with the lesion at surgery. This technique is cost effective and useful, especially if no prosthodontist is available at the time of the surgery to perform the obturator modifications.[42]

Mekayarajjananonth et al said that traditional methods of fabricating orbital prostheses rely on the “lost wax” technique to produce a realistic representation of the sculpted pattern produced in the defect. The usual constituents of the mold that reproduces the subtleties of the palpebral fissure are often minute, making them prone to fracture and subesquent dissolution by repeated attempts at pressing each prosthesis. They provided a mold resistant to these problems with light polymerised resin surrounding the palpebral part of the orbital mold.[43]

Mark Marunick and Nicholas Tselios conducted a review to assist the clinician in determining the efficacy of palatal augmentation prosthesis for the patient undergoing glossectomy. A total of 50 subjects were studied, 42 for swallowing and 37 for speech. In 36/42 subjects, treatment was advantageous for swallowing and in 32/37 subjects it was advantageous for speech. On the basis of limited evidence available, the functional efficacy of the palatal augmentation prosthesis is supported.[44]

Habib and Driscoll describe a technique for fabricating a closed, hollow bulb obturator. It allows for control of bulb's wall thickness and weight while not requiring any additional materials or time consuming steps to the conventional processing procedures.[45]

Jiao et al described a new technique for fabricating auricular prostheses by CAD-CAM system. A spiral CT was performed on a patient who had a right ear defect. A 3 D image was reconstructed. The image of normal ear was mirrored and was modified so that it could adapt to the deficient side. A paper model ear was manufactured by prototyping and finally silicone prosthesis was made. This technique is easier faster and digital image can be preserved than the routine.[46]

Savion and Huband describe a method for the fabrication of a feeding obturator for a preterm baby. It can be effective in overcoming some of the feeding problems associated with a cleft palate defect. An obturator prosthesis may also reduce this stress on both parents and the baby. They promote neonate weight gain, which is important in preparing the baby for corrective surgery.[47]

CHAPTER 3: DEFINITION, OBJECTIVES, TYPES OF MAXILLOFACIAL PROSTHESIS

By Dr. Amar kumar

Maxillofacial prosthetics is 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.[48]

OBJECTIVES OF MAXILLOFACIAL PROSTHESIS

1.Restoration of esthetics or cosmetic appearance of the patient.

2.Restoration of function.

3.Protection of tissues.

4.Therapeutic or healing effect.

5.Psychologic therapy.

CHAPTER 4: TEAM APPROACH IN MAXILLOFACIAL PROSTHETICS

By Dr. Amar Kumar

There are three types of maxillofacial defects.

Congenital

Cleft palate

Cleft lip

Facial cleft

Missing ear

Prognathism

Acquired

Accidents

Surgery

Pathology

Developmental

Prognathism

Retrognathism

Maxillofacial prosthetic repair is indicated when anatomic parts of the head and neck are not replaceable by living tissue, when a recurrence of malignancy is envisaged, when radiotherapy is being instituted, when fragments of facial bones are displaced in a fracture. A temporary prosthesis may be used to cover a defect when plastic surgery repair requires many steps. Speech appliances may be used when surgery is contraindicated for closure of cleft palate.

Advantages: it requires little surgery or no surgery, the patient spends less time away from home and job, and the reconstruction is often more natural looking.

Drawbacks: include the necessity of fastening the appliance to the skin and removing it every day and the occasional need of constructing a new prosthesis.

THE TEAM APPROACH IN CASE MANAGEMENT

The maxillofacial prosthodontist serves primarily as a member of a team and must cooperate with the other members in planning rehabilitative treatment for patients with maxillofacial defects.

Some unusal requirements are imposed upon the maxillofacial prosthodontist in that he not only uses the methods and techniques of the conventional prosthodontist, but he must have additional knowledge of the anatomy, physiology, and pathology of the orofacial structures involved.
Special training and skills as well as imagination are required to meet these challenges.

Medical – Dental Relationship

An active hospital dental department, which may include a maxillofacial prosthetic division, can supply a wide range of dental services in the hospital setting. He can use various hospital services, such as nursing, social work, speech therapy, occupational therapy, occupational rehabilitation, and physical therapy, in the management of his patient.

It is important for each individual member of the team to be aware of the capabilities as well as the limitations of various other specialties involved.

The surgeon

Adequate preoperative consultation with the surgeon is often helpful both in the management of the primary disease process and in the postoperative rehabilitation of the patient.

If a temporary or permanent prosthetic appliance is anticipated, the prosthodontist may advise the surgeon as to the most desirable type of tissue base but the surgical procedure cannot be compromised for the convenience of the prosthodontist if it endangers the cure or hope of cure.

When tissue stents or obturators are to be inserted at the time of surgery, the prosthodontist trained in maxillofacial prosthetics must be involved in the preoperative planning, and he must also be present at the operation, since he may have to revise the appliance by the use of quick cure acrylics or other materials. Postoperative management of the surgical patient also requires liaison between surgeon and prosthodontist.

The Radiotherapist

The use of radiation or radiomimetic agents in treating cancer of the oral regions requires close cooperation between the therapist and the dentist. Radium source carriers are often required to control the radiation at the lesion site.

A prosthodontist may be asked to render an opinion regarding the management of teeth that may be in the line of radiation of the oral regions, to extract teeth preoperatively, or to maintain the health and integrity of the teeth in an irradiated area.

The Speech Therapist

The speech therapist plays an important role in rehabilitating the patient with maxillofacial defects.

Speech defects resulting from developmental disturbances, surgery, or other therapeutic measures require careful analysis, and the speech requirements may modify the construction of the proposed appliance. The prosthodontist must have sound knowledge of the physiology and mechanics of speech, and he must be prepared to construct his appliance to fulfill the requirements of phonation, resonance, and articulation.

The Psychiatrist

The emotional aspects of gross defects of body integrity, especially of the head and neck regions, may play a key role in the rehabilitation of the patient.

Even though therapy has been effective and a clinically successful prosthesis has been constructed, the patient's rehabilitation cannot be considered complete until he is also emotionally conditioned to accept his deformity, the appliance, and the prospects of recurrence of disease, as well as certain social and financial adjustments.

The Social Worker

These specialists are trained to communicate with people at all social and economic levels, they are often able to allay the fears and misconceptions of the patient and his family about the nature of the disease, the treatment and prognosis, and the possibilities for physical and social rehabilitation.

Other Dental Specialists

The need to maintain periodontal health may require the services of a periodontist, or an oral surgeon may be called upon for extractions in fields to be irradiated. Cooperation with the orthodontist is almost invariably required in the effective management of the cleft lip and palate cases. The oral pathologist will be of value in the diagnosis of oral lesions, particularly those involving the odontogenic and salivary gland tissues. For problems involving children, the pedodontist should be consulted.

Challenge of the Future

As the scope of maxillofacial prosthetics training programs continues to expand both in depth and breadth, the quality of patient service will improve.

With continued acceptance of the prosthodontist who specializes in maxillofacial prosthetics as part of the team charged with rehabilitation of these patients cooperative effort in treatment planning is assured. This multidisciplinary approach will result in added benefits to the patient.

CHAPTER 5: DIAGNOSIS AND TREATMENT PLANNING

By Dr. Abhishek Gupta

Diagnosis. A complete oral examination and the medical history should be reviewed in detail.

Patient Record. Appropriate records must be maintained for each patient. These may include radiographs, laboratory reports, photographs, moulages, and study models as well as the usual personal data, dental charts, medical questionnaires, and operative notes.

When appliances involving some form of attachment to the teeth are required, comparing earlier intraoral radiographs with current dental findings can provide some basis for judging the dental caries rate or the progress of periodontal disease.

Patient Interview. During the preliminary discussion, his gait, mobility, vigor, complexion, and speech can be noted. His attitude regarding the proposed treatment can often be determined.

Past Medical History. The nature of the disease process, its natural history and the type of therapy employed must be considered in the long-range treatment plan. Past medical history may be used to establish the presence or absence of disease states such as diabetes, arthritis, anemia, tuberculosis, epilepsy, or other diseases.

Dental History. Should pursue the patient's past dental history and experiences, particularly as related to frequency of dental care, oral hygiene habits, and complications from tooth extraction. Since maintenance of the existing dentition in a healthy state may determine the success or failure of the prosthetic appliance, considerable attention should be given to instruction in home care and periodic dental prophylaxis and treatment.

Chief Complaint. Let the patient describe in his own words what he feels is required, his reasons for wanting the device. At this time he can express his expectations of the rehabilitation procedure.
The treatment plan may be modified to fulfill the patient's primary expectations, such as a need for a device to aid in speech and eating or to improve his appearance.

Physical Examination. All available diagnostic techniques should be used, including inspection, palpation, determination of function, aspiration, probing, auscultation, transillumination, and fluorescence.
The mobility of teeth and depth of periodontal pockets, presence of calculus, and other obvious dental defects should be evaluated and recorded.

Extraoral examination includes the face, neck, skin, hair, eye, and ear. The face should be examined for asymmetry, enlargement, or other gross development defects. The intercanthal distance, position of the ears, abnormal hair growth patterns, or other development defects of the head and neck should be recorded.
The lymph nodes of the neck should be palpated. The function of the temporo- mandibular joint, the muscles of mastication and facial muscles should be determined by having the patient open and close the jaws in protrusive and excursive movements.
The examination of the lips should note any changes in consistency and color of the vermilion border or developmental or acquired defects at the commisures. Bimanual palpation extending into the mucobuccal fold of both lips is necessary to determine muscle tone or the presence of deep-seated nodules or masses.

Direct inspection of the buccal mucosa should be made with the jaws partially closed in order to relax the cheek muscles. Both direct inspection and palpation should include the mucobuccal fold areas, the substance of the cheek mucosa and skin, the associated buccinator and masseter muscles, the pterygomandibular raphe, and the retromolar triangle areas.

Examination of the dorsum of the tongue should be extended to the posterior areas by depressing the tongue. The deep substance as well as the critical lateral borders of the tongue may be palpated by grasping the tip of the tongue with gauze squares and pulling the tongue forward and laterally.

Deep palpation of the floor of the mouth and associated major salivary glands requires bimanual palpation, with one finger in the floor of the mouth and the others placed beneath the chin.

The palate is examined by direct inspection and palpation. The incisive papilla region, the hard palate on either side of the midline, and the junction of the hard or soft palate are also examined.

The teeth and periodontal structures should be examined individually, and restorations, caries, malformations, hypoplastic areas, mobility, position, and evidence of abrasion or attrition should be recorded.

The alveolar process and supporting bone of the jaws should be palpated for evidence of asymmetry or enlargement.

Radiographic Examination. Appropriate radiographs should be used to provide the information required. Routine periapical radiographs, other extraoral radiographs including panorex and cephalometric radiographs may be required.

Laboratory Examination. Biopsy, cytology, salivary function tests, examinations of the blood and urine, microbiologic studies, skin tests and tests of endocrine function.

Summary of Clinical Findings. Upon completion of the physical examination and evaluation of the medical and dental history, together with any laboratory findings, a final summation should be prepared and placed in the patient's permanent record.

Treatment Plan. The primary objective is to cure or control the basic disease and to prevent further disability.

Second, the overall objective of the total plan should contribute to the patient's well being, acceptance by his family and friends, and his return to society as a useful member.

The detailed treatment plan for the maxillofacial prosthesis is established after final evaluation of the physical and radiographic findings, analysis of study casts and or moulages. The maxillofacial prosthetics patient should be warned of possible functional difficulties that may require adjustments, the services of a speech therapist, or other special training.

CHAPTER 6: MATERIALS FOR THE FABRICATION OF MAXILLOFACIAL PROSTHESES

By Dr. Kishore Kumar

The most common materials currently in use for the fabrication of intra and extraoral prostheses are polymeric in nature. These include vinyl chloride polymers, acrylic copolymers and finally silicone rubbers, both heat-vulcanizing type and the room temperature vulcanization (RTV) type.

Materials

Vinyl Polymers and Copolymers: The amount of vinyl acetate in the polymer varies from 5% to 20%. Copolymers of vinyl chloride and vinyl acetate are more flexible but less chemically resistant than polymethyl chloride.

Polyvinyl chloride is a clear, hard resin, which is tasteless and odorless. It darkens when exposed to ultraviolet light and heat, and it requires heat and light stabilization to prevent discoloration during fabrication and use.

Polyvinyl acetate is stable to light and heat but has an abnormally low softening point (35 to 40^0 C)

Acrylic Resins: Acrylic resins are used in the fabrication of both intra- and extraoral prostheses. In powder form, these resins can be injection- and compression- molded or, in dough form, they can be molded in gypsum molds.

Methyl Methacrylate: The liquid monomer, methyl methacrylate, is usually mixed with the polymer, which is in the powdered form. The monomer partially swells the polymer to form plastic dough. This dough is packed into the mold, and the monomer is polymerized by ultraviolet light or heat, as well as by chemical initiations.

Volume shrinkage of 21% occurs during the polymerization of the pure monomer.

Polymethyl Methacrylate: It is a transparent resin of remarkable clarity and has a Knoop hardness number of 18 to 20.

The resin is extremely stable, it will not discolor in ultraviolet light, and it exhibits remarkable aging properties. It will soften at 260^0 F (125^0 C), and it can be molded as a thermoplastic material. Between this temperature and 400^0 F (200^0 C), depolymerization takes place. At approximately 850^0 F (450^0 C), 90% of the polymer will depolymerize to the monomer.

The physical structure of methyl methacrylate allows for ease of cleaning, and its stability of form enables a restoration to be worn for a considerable time before being remade.

From the standard methyl methacrylate denture base resins, a satisfactory basic skin shade can be achieved and varied to simulate skin tone characteristics with accuracy[49]

4 m of Stellon pink

8 ml of Stellon Veined

5 ml of Stellon clear

4 ml of Stellon C. 2, light yellow.

4 ml of Stellon C. 4, dark yellow.

2 ml of Stellon C. 6, light gray.

1 ml of Dentine stain, yellow

1 ml of Dentine stain, orange

1 ml of Dentine stain, gray

1 ml of Dentine stain, light brown

All powders are to be incorporated together.

Acrylic paints dispensed in methyl methacrylate monomer also reproduce skin color accurately. The wax or clay prosthesis is invested to have external surface for coloring during packing stage. The wax is boiled out, and the separating medium is applied.

Basic skin shade polymer is mixed with monomer and allowed to attain a soft dough stage. The dough is packed into the mold, and the flask is closed. The surface of the prosthesis is painted with monomer to fuse the stains with the basic skin shade. A layer of clear polymer is placed over the color, to tone down the color and seal the surface. Conventional polymerization times are used. The prosthesis is de-flasked. A problem with methyl methacrylate prostheses is surface sheen. This can be overcome by sandblasting at 40 psi with an acrylic blasting grade sand. An alternative method is to stipple the surface with a small round bur. An acrylic varnish when painted on the acrylic, high gloss surface results.

Characterization

The methyl methacrylate prosthesis is tinted with acrylic paint suspensions. Because of the accurate skin shade and characterization that can be achieved at the packing stage, only minor tinting should be necessary.

Autopolymerizing Acrylic

This acrylic can be used to augment margins of a rigid acrylic prosthesis when in position on the patient's face.

Recent developments with acrylic resins

Light – cured acrylic

The introduction of light – cured polymers has been a useful tool for provisional prostheses intraorally and extraorally. The characteristic brittleness, inability to stain, and poor thermal conductivity of these acrylics point to the use of methyl methacrylate as the acrylic of choice for most acrylic prostheses.

Copolymer

Combining acrylic polymers of high molecular weight with blocks of other polymers is an attempt made to obviate the problems encountered with the original acrylic copolymers.

Palamed is one of the prototypes of plasticized methyl methacrylates, or copolymers, used in maxillofacial prosthodontics. The prostheses made of copolymers tend to be less durable and require more frequent repairs because of marginal tears.

Polyurethanes

This material is chemically composed of an extended segment of diisocyanate groups and a segment of polyol groups (a mixture of polyesters) and an organo tin catalyst for the polymerization process to occur. Epithane – 3 and Calthane are the only polyurethanes currently available for fabricating facial prostheses. The diisocyanate component is hazardous, toxic and moisture sensitive.[50]

Gonzalez studied the various physical and mechanical qualities of polyurethane with the parameters of surface hardness, modulus of elasticity, strength, and percentage of elongation and strength to modulus of elasticity ratio. The results of the study confirmed that these physical and mechanical properties can be altered and customized to suit the prosthetic situation by varying the ratio of Part (A) to Part (B) and addition of catalysts.[51]

Silicones

The silicones were introduced around 1946. The term‘‘ silicone’’ covers many related but different materials. They come in many forms, such as liquids, gels, greases, defoamers, waxes, rubbers, resins, and reactive chemicals. Each form has different characteristics peculiar to its use.
Silicones consist of chains of alternate silicon and oxygen atoms, which can be modified by attaching various organic side groups to the silicon atoms or by cross-linking the molecular chains. Silicones range in properties from rigid plastics through elastomers to fluids.

The four categories of silicone are based on application.[52]
Implant grade: This material must at least meet or exceed food and drug administration requirements. The materials used in breast implantation have led to investigation (medical and legal) into the cytotoxicity of this material. More stringent testing is performed on this grade of silicone.

Medical grade: This material is used externally and is found primarily in facial prostheses. Some studies test the cytotoxicity of this material; however, none has reported any negative side effects.

Clean grade: this material applies to use with food coverage and packaging.
Industrial grade: This material is mostly used for industrial purposes.

Silicones used in maxillofacial prostheses can be cured either at room temperature or by heat.

RTV Silicones: According to Braley, the room temperature-vulcanizing silicone rubbers are composed of comparatively short chain silicone polymers, which are partially end blocked with hydroxyl groups. In addition, a cross linking agent such as tetraethyoxsilane (ethyl orthosilicate), is used. Gypsum molds are used in the fabrication of prostheses from RTV silicones. A technique for tinting utilizing RTV silicone is suggested by Lepley.

The RTV silicone is blended with suitable earth pigments to produce the patient's basic skin color. The cured prosthesis is removed from the mold and thoroughly cleaned with chloroform preparatory to color-matching the prosthesis to the patient's individual requirement. A medium for tinting can be made from uncured RTV silicone and distributed to the desired consistency with xylene to which pigments are added.

The prosthesis is allowed to stand overnight to permit the xylene to evaporate. The catalyst is then gently applied over the tinted surface with a brush or cotton applicator. Stippling or other skin characterizations can be accomplished at this time. The surface is allowed to cure for several more hours before polishing. The glossy surface of the prosthesis is dulled to the desired degree by abrading the surface with wet flour of pumice.

Ouellette has described a new technique for spray coloring a silicone elastomer. In this method, the RTV elastomer prosthesis, containing

pigments, which impart a basic shade to the elastomer, is sprayed by an artist's airbrush with pigment dispersions diluted with xylene to a spraying consistency.

The desired amount of the pigment concentrate is added to RTV elastomer, which is then cast to give a prosthesis of required basic shade. A piece of gauze dampened in xylene is used to sponge the prosthesis. This treatment results in a satin finish and more lifelike appearance.

Silicone foam (silastic 386)

Firtell et al investigated Silastic 386 in 1976 for situations in which the weight of a prosthesis is an issue**.** They tested the feasibility of combining foam RTV silicone rubber with conventional RTV silicone rubber to obtain a material that is lighter in weight. An element in silicone, when mixed with a stannous octoate catalyst, releases a gas in the vulcanization process as bubbles are released with the resulting silicone mass being increased and density being decreased, which presents a much lighter material. This process requires special flasks to deal during processing. The mold also requires venting for gas release and reduction of expansion of the prosthesis.[53]

Application of the foam is reported by Casey et al for the fabrication of an intracavity radiation prosthesis and tissue compensator, and it is important to be aware of this product as a potential maxillofacial prosthetic tool.[52]

Heat-vulcanzing Silicones: The mechanism for the formation of a heat vulcanizing silicone rubber involves the use of a diorganopolysiloxane, such as polydimethyl siloxane.

When this material is heated with benzoyl peroxide $(C_6H_5\text{-}COO)_2$, a reaction occurs between one of the methyl radicals in the chain and a similar methyl group in an adjacent chain. Thus, the two polymers are cross-linked, with bezoic acid formed as a by-product.

Various silicone rubbers have been made available for use by the maxillofacial prosthetist. These include silastic S-6508, silastic 382, and silastic 399.

Silastic S-6508 in the raw state is similar to sticky modeling clay. It must be vulcanized at 260^0 F and formed in pressure molds.

Silastic 382 is an opaque white fluid with a viscosity like that of thick honey. It sets up to a rubber without the evolution of heat within a few minutes after its catalyst, stannous octoate is incorporated.

Silastic 399 resembles white Vaseline in its raw state. It is easily spatulated but is nonflowing. Upon mixing with catalyst I, the cross-linking agent, it becomes some- what milky, but it can be worked for several hours.

Chalian discussed the milling of HTV silicone using a two – roll mill with a motor drive so that greater translucency can be obtained with increased dispersion of internal pigments used. The next processing step involves curing in a heat transferring metal mold at high temperatures. The milling process significantly reduces the potential for trapping air and consequent porosity that frequently occurs with hand incorporation of pigments with RTV silicones.[54]

Pigmenting and Coloring Heat-vulcanizing Silicone

Two ways of doing this: extrinsic and intrinsic. In extrinsic coloring, the pigments in the form of paints or dyes are applied directly to the surface of the finished prosthesis. In intrinsic coloring, the pigments are added directly to the silicone prior to curing. A prosthetic restoration colored by

the intrinsic method will retain its color. There is no risk of the pigments wearing off of the surface of the prosthesis.

Pigments used with silicone rubber are always inorganic compounds such as metallic oxides. The different color pigments are added until the desired skin tone is attained. Nylon flock is then applied to the tissue side of the mold to duplicate blood vessels, and the mold is then packed with pigmented silicone. Vulcanize in a dry heat oven at 170^0 C for approximately 20 minutes. After removal from the metal mold, the prosthesis is checked on the patient, and imperfections in the skin are duplicated by means of tattooing with watercolors.
A silicone adhesive is used for retaining the prosthesis.

In a survey conducted by Andres regarding the use of extraoral maxillofacial materials, MDX 4-4210 has been used by 41% of clinicians surveyed. This material popularity is because of its improved physical properties, which have been investigated thoroughly, such as increased resistance to tear, surface texture and shore A hardness measurements being within the range of human skin and its compatibility with most skin adhesives. It also has proved to be quite color stable.[55]

Haug et al have reported that dry earth pigments, kaolin, and rayon flocking acted as a solid filler without bonding to the silicone, and artist's oils and liquid cosmetics acted as a liquid base without bonding to the silicone matrix. The addition of colorants could have a stabilizing effect on the elastomer color when it is exposed to weathering.[38]

Hulterstrom evaluated the changes in appearance of silicone elastomers for maxillofacial prostheses as a result of aging and found that the condensation – type polymers had an increased opacity in an aqueous environment, whereas the addition type polymers showed the smallest color changes. Despite the higher content of filler in the addition – type polymers, they generally displayed lower opacity than the condensation – type polymers. Because of the higher viscosity in the condensation – type

polymers, however, they may present a greater potential for intrinsic coloring.[56]

Mohite et al studied the effect of environmental factors on the physical properties of elastomers for facial prostheses, particularly two silicone elastomers (MDX-4-4210 and Cosmesil) and a polyurethane (Epithane – e). The test results indicated a significant difference in the tear characteristics between silicone and polyurethane and between the control and specimens exposed to environmental factors. These environmental factors affected the urethane the most and MDX 4-4210 the least. Chlorine and nitrogen dioxide exposure influenced degradation of Cosmesil and Epithane – 3 to the point at which sample testing was impossible and ultraviolet radation exposure influenced degradation of Epithane – 3 to the point that it could not be tested. Simulated sebum and ozone did affect Cosmesil and Epithane – 3 with no trend observed.[57]

Waters et al compared the wettability of various silicones with denture acrylic resin material and found no significant differences in the surface energies of the silicones, but all were significantly lower than denture acrylic resin.[58]

Anderopoulos et al found that wetting properties degraded with increasing silica volume fraction. Evaluation of this property is necessary with each polymer modification in an effort to fabricate improved maxillofacial prosthetic materials.[52]

Newer silicone polymers (A-2186), Cosmesil, siphenylenes and silicone copolymers

The modification of the silicone polymer has led to some of the newer materials currently in use, such as A2186 (factor II) and Cosmesil Factor II has displayed physical properties that were at least as acceptable or better than those of MDX 4-4210.[59]

These enhanced physical properties did not last after environmental factors were imposed, however, and MDX 4-4210 had superior physical properties relative to Factor II in a study conducted by Haug et al.[60]

Wolfaardt discussed the advantage of Cosmesil's ability to process to variable levels of hardness and have higher tear strength than MDX 4-4210. Verse et al also studied other properties of this material.[61]

Siphenylene polymer is another siloxane copolymer that has phenyl and methyl groups and exhibits much in the way of improvements with respect to improved edge strength, superior coloration and low modulus of elasticity relative to other conventional TRV silicones in use for maxillofacial prosthetics.

Finally, some of the new avenues of current study involve silicone block polymers in which blocks of polymers other than siloxane are positioned with the traditional siloxane polymers in an attempt to modify the current physical properties of conventional silicone. An example of this is the interwining of polymethyl methacrylate into the chains of siloxane. This material is currently under study.

Fabricating Techniques

Leonard lists the following chemical criteria for synthesis of polymers for maxillofacial prosthesis. The polymer should:

1.Be flexible without the addition of plasticizers.

2.Be chemically saturated.

3.Not have labile groups on chain backbone or side chains.

4.Be vulcanizable and thermosetting or regularly oriented.

5.Have high gum stock strength or be compoundable with fillers whose refractive index is equivalent to the base polymer so that translucent films can be achieved.

6.Be dispersed in liquid form so that low pressure casting techniques may be utilized.

The technique developed at the United States Army Medical Biomechanical Research laboratory used low pressure molds and differs from other designs in that it results in a two-component prosthesis consisting of an outer layer of skin made of a synthetic elastomer which covers an inner layer or foam filler made of silicone foam rubber.

The material developed for the fabrication of the outer layer or skin of the two-component prosthesis is a latex-dispersed synthetic elastomer: a terpolymer of butyl acrylate (90%) methyl methacrylate (7.5%), and methacrylamide (2.5%).

The elastomeric film cast from the compounded latex technique is known as the acrylate skin.

Pigments and their application in maxillofacial elastomers[62]

Lewis et al stated that, the ideal color properties required in a maxillofacial prosthetic material must accept and retain intrinsic and extrinsic coloration, and that the appearance and mechanical strength of the prosthesis must not change by sunlight or other environmental factors.

Mayer stated that pigments could be classified according to their color and origin. The term “organic” can be applied to pigments of an animal, vegetable or synthetic origin. The term inorganic can be applied to pigments of mineral origin. Inorganic pigments can be native earths (ocher, raw umber) calcined native earths (burnt umber, burnt sienna) or synthetic origin (cadmium yellow, zinc oxide)

Organic pigments have a limited life span and are more subject to decay on aging and exposure to adverse environmental conditions.

Internal pigments may result in less loss of color, because there would be less chance that the pigments would be dissolved during cleaning the prosthesis. The possibility of using UV absorbers may be a partial solution regarding pigments stability of facial prostheses. Patients should be

encouraged to avoid prolonged exposure to sunlight and to use brimmed hats and sunglasses. They should avoid using cosmetics on the prosthesis; even if water based makeup is used, the repeated washing may dissolve and remove some pigments on the external surface. Patients should not use any solvents such as isopropyl alcohol to clean the prosthesis, which could cause dissolution of the pigments. Patients should avoid smoking, which could stain a nasal prosthesis.

Coloration

The process of establishing a color for a prosthesis is essentially broken down into intrinsic and extrinsic staining of the prosthetic material. Intrinsic staining is the stage at which a base shade is established, whereas extrinsic staining involves further characterizing of the initial intrinsically stained prosthesis to attain esthetically optimal results.[52]

Intrinsic coloration

The primary goal of intrinsic colorizing is in imitating the physiologic coloring with pigments incorporated into a compatible commercial base material**.**

Lontz et al discussed the physiologic details of skin in terms of colors: arterial red, venous red – purple, carotenoid yellow, melanoid brown, and opaque cellular lipids. These works [80] presented a range of intrinsic color shades to serve as a bulk coloration onto which extrinsic staining can characterize the prosthesis further.[52]

Johnston et al established a translucency parameter by collecting optical scattering and absorption coefficients and applying the Kubelka – Munk reflectance theory. The actual procedure involved measuring the colored medical – grade silicone sample, which was placed on an ideal dark backing and an ideal white backing. Significant differences were noted among the translucency parameters of the colorants.[25]

Lemon et al assessed the efficacy of an additive, intrinsic, broad spectrum UV light absorber on the color stability of pigmented elastomer. The material was weathered artificially and outdoor at exposure levels of radiant energy of 150 to 450 kj/m^2, with a perceptible color change reported.[63]

Tamamata et al study suggested that aging is the primary influence on color changes observed in HTV and RTV base polymers, as opposed to exposure to sunlight.[64]

The use of ceramic pigments as applied to maxillofacial prostheses was evaluated by Seluk et al. Samples of unsintered versus sintered pigmented porcelain were mixed into Silastic 44210 and evaluated with respect to color stability after accelerated aging. There was clear demonstration that sintered pigments were more color stable than unsintered pigments.[17]

Extrinsic coloration

Most extrinsic staining involves the use of a medical grade silicone adhesive that is thinned with xylene to a more liquid consistency. The pigments are then distributed into small amounts of this mixture on a palette for application to the prosthetic surface.

Adjustments can be made by reapplication if more color is needed or conversely by removal of excess color with chloroform. This method of extrinsic coloration is relatively easy and effective. An extrinsic method of coloring that was introduced by Schaaf is tattooing. A fine needle penetrates paint approximately 2 mm below the prosthesis surface. After the various shades for characterization are prepared and incorporated into the base material with a tattooing machine.[52]

CHAPTER 7: THE IMPACT OF ENDOSSEOUS IMPLANTS ON MAXILLOFACIAL PROSTHETICS

By Dr. Surendra Kumar Acharya

Historically, the continuing loss of supporting structures left patients with increasing levels of physiologic and cosmetic deficiency. Compensation for unfavorable anatomy generally requires surgical alteration of the defect area, alternative methods of external fixation, mechanical engagement of tissue undercuts, or the use of denture or skin adhesives.

As an alternative method, endosseous implants may be used to address the concerns of diminished support, retention, and stability.[65]

Implants are placed into the residual bone and then used for retention, support, and stability of prosthesis. Use of similar implants in extraoral sites is growing in popularity, especially for the retention of auricular prostheses and for bone – anchored hearing aids (BAHA).[66]

Prosthetic designs and strategic implant placement must anticipate the functional demands of the prosthesis while also recognizing the dislodging forces applied to it. When considering maxillary defects implants are of great benefit in providing retention, but their use for support and stability may be risky. With extraoral defects, support and stability of the prosthesis are unlikely to overstress the implants. Similarly, retention of an extraoral prosthesis is limited to the resistance of gravitational forces.[67] The weight of the prosthesis, mass times gravity, must be resisted by the retentive features to prevent dislodgment of the prosthesis.

Auricular prostheses

Endosseous implants specifically designed to be placed in the temporal bone permit positive retention. The main complication in this area is related to the difficulty in maintaining adequate hygiene around the skin

penetrating implants. Holgers et al report adverse tissue reactions in approximately 11% of patients receiving these implants.[68]

Endosseous implants may also be used to secure bone – conduction hearing aids. BAHAs have demonstrated efficacy in patients with intact middle – ear components but with damaged external ear structures.

The temporal bone has sufficient thickness to accept a 3 or 4-mm implant. Minimum of two implants are needed, positioned approximately 18 mm from the center of the external auditory meatus and 15 mm from each other. This design permits better support, stress distribution and retention of the prosthesis.

The abutments are joined by a bar constructed in a C-shaped design to improve the stability and retention of the prosthesis. Three retentive clips or magnets and a bar do not appear to compromise the contours of the prosthesis. An acrylic resin section is constructed within the prosthesis to house the retentive elements.[69]

Nasal prostheses

Surgical margin extension is different for every patient making use of implants in this area difficult. Implant success is highest when placed into the superior surface of the maxilla and used to retain the inferior aspect of the nasal prosthesis.[70]

The bone quantity and quality in the glabellar region of the frontal bone is limited, and implants at the superior aspect of a nasal defect usually cannot be placed. A U – shaped retentive bar connected to the implants at the base of the U will provide three points for retention: the two vertical struts and the horizontal crossbar. Retentive clips or magnets are used to secure the prosthesis.

For a nasal defect, the anterior surface of the maxilla just inferior to the nasal cavity offers sufficient thickness of bone and an optimal position

for 4-mm implants. Longer implants, 6 mm or greater, are possible in this area. It is recommended that a waxed pattern of the prosthesis be completed before the placement of the implants so that the position of the abutments and the retentive elements do not compromise the contours of the prosthesis.[23]

Orbital prostheses

As orbital defects increase in size, the need for implants support becomes greater. The implants are generally located in the supraorbital rim or in the lateral rim of the residual orbit. Medial placement of the implants is discouraged due to diminished bone quantity and quality in this area and the associated reduced implant survival rates in bone of low quality.[71]

For an orbital defect, the superior, lateral, and inferior orbital rims are possible sites for 3 or 4 mm implants. Ideally three or four implants are needed. The long axes of the implants should be directed toward the center of the orbit. If some implants are directed posteriorly towards the cranial fossa while other implants are directed anteriorly, the path of insertion may not accommodate a one – piece retentive bar.

Mandibular defects

Mandibular discontinuity subsequent to ablative tumor surgery is effectively managed by immediate or delayed surgical reconstruction to re-establish continuity. Endosseous implants in this grafted bone will allow the placement of a dental prosthesis that does not create deleterious compressive forces on the graft.[72] The resected mandible that has not been reconstructed will have a deviated opening and closing arc. The angle of mandibular closure will place forces on the implants that are not in line with the long axis of the implants.

Hard and soft Palate defects

Large obturator prostheses place substantial forces on the residual structures. When implants are used to retain such prostheses, it is essential that the different forces be considered. These prostheses have a tendency to

rotate into the defect area when occlusal loads are placed on the defect side but to rotate out of the defect area as gravity exerts its pull on the prosthesis.[73]

Endosseous implants in residual maxilla must be of sufficient number, length and distribution to resist the anticipated complex forces of mastication and dislodgment. Four implants in the intact maxilla has been suggested as the minimum number for support of overdenture prostheses.[74]

If the implants can be distributed bilaterally, more acceptable forces will be generated to the implants and better retention and stability will be achieved. Soft palate defects are normally associated with bilateral maxillary support. The primary function of implants is to retain the prosthesis and to support the occlusion.

CHAPTER 8: NUTRITIONAL CONSIDERATIONS FOR MAXILLOFACIAL PATIENTS

By Dr. Abhishek Gupta

A prime requisite for healing and recovery after maxillofacial surgery is adequate nutritional status of the patient.

The primary concern in defects such as cleft lip and palate is to provide a functional route to receive nourishment. Early closure of these defects by surgery or mechanical obturation is desirable.

Patients with acquired defects generally require the same nutritional management, but they may also require special considerations.

Basic Diet

The basic dietary requirements for the surgical patient includes adequate amount of protein, vitamins, and minerals. Sufficient calories from carbohydrates and lipids are necessary to provide energy.

Four major food groups with recommended daily intakes.
Milk Group
Children: 3 to 4 cups; teenagers: 4 or more cups; adult: 2 or more cups.
Meat Group
1 or more servings; beef, veal, pork, lamb, poultry, fish, eggs 4 or more servings; include citrus fruit or other fruit or vegetable important for vitamin C; dark green or deep yellow vegetables and fruits, including potatoes
Bread-Cereal Group
4 or more servings of whole grain, enriched, or restored products.

The types of diet that would most often be used or the maxillofacial patient are the liquid, mechanical, soft, and regular. While the patient is hospitalized, other means of nourishment may be necessary, such as intravenous feedings.

A patient with severely impaired ability to masticate will require a liquid diet. Those patients with limited chewing function may require a combination liquid – soft diet. When the masticatory function is relatively unimpaired, a regular diet may be prescribed. The most important element is the quality of the regular diet in terms of protein, vitamins, minerals and calories.

The liquid diet is the hardest to plan because of the difficulty in providing sufficient protein and calories in a form acceptable to the patient.

The soft diet allows more freedom in selecting food items and also is less monotonous than the full liquid diet. Raw vegetables, nuts, and seeds are avoided, not only because of chewing difficulty but also because particles may become lodged under newly inserted appliances.

The regular diet requires the intake of a sufficient quantity of protein, calories, vitamins, and minerals.

Use of Proprietary Food Supplements

The American Dental Association has classified the following protein vitamin mineral food supplements as acceptable.

Nutrament is stated to be a nutritionally complete liquid food, of which, each 12.5 fluid oz provides 375 calories with 25 grams of protein, 11 grams of fat, and 44 grams f carbohydrate, plus all known essential vitamins and minerals.

Instant Nutrament is stated to consist of nonfat dry milk, sugar, corn syrup solids, artificial flavor, and essential vitamins and minerals. Each packet contains approximately 25% protein, 0.9% fat, and 65% carbohydrate, and provides 215 calories.

Carnation instant Breakfast is stated to consist of nonfat dry milk, sugar, corn syrup solids, flavoring agents, and essential vitamins and minerals. Each packet contains approximately 25% protein, 1.8% fat, and 65% carbohydrate, and provides approximately 130 calories.

Carnation Slender is stated to consist of nonfat dry milk, lactose, corn syrup solids, flavoring agents, and essential vitamins and minerals. Each packet contains approximately 45% protein, 2.9% fat, and 34% carbohydrate, and provides 63 calories.

CHAPTER 9: PSYCHOLOGICAL CLASSIFICATION AND INTERPRETATION

By Dr. Abhishek Gupta

House's classifications of philosophical, exacting, indifferent and hysterical categorize the mental status of patients. As the maxillofacial patients quality of life is altered and social integrations becomes difficult, the patient's expectations to return to "normalcy" often collapse. It is critical for the prosthodontist to assess whether treatment should be performed at all, delayed until the patient's demeanor is more conducive to treatment, and/or coordinated with services of supportive professionals such as social workers or psychologists.[75]

Mc Grouther concludes that even minor facial abnormalities can result in social stigma.[76]

Bull and Rumey used researchers given cosmetic facial abnormalities as stooges, so that the behavior of the general public could be observed. Members of the public showed marked avoidance of the stooges, and rated persons with facial abnormalities as less intelligent, less friendly, and less sociable than persons without facial abnormalities.[76]

Rozen et al found that the effect of primary cancer treatment was a marked reduction in meeting both friends and acquaintances in private and in public places, with some patients becoming socially isolated. Given the social stigma associated with facial abnormality, it has been suggested that persons with facial abnormality experience greater psychologic disturbance such as low self – esteem depression, and dissatisfaction with appearance.[76]

Lowental and Sela asked respondents to indicate their psychologic adjustment after maxillofacial restoration by agreeing or disagreeing with a series of statement. In a series of 52 patients, all but 3 of the respondents indicated a healthy adjustment to the prosthesis. The patient's adjustment after the provision of the prosthesis is related to the nature of the loss they have experienced, those patients who received prosthetic treatment after trauma improved more than those who required a prosthesis after treatment for neoplasia.[76]

The prosthodontist understands the various psychological diagnoses, ranging from subtle emotional nuances to overtime successful prosthodontic treatment. Most people can recover from mental illness and return to normal lives with appropriate referral and treatment.

Psychological changes in the maxillofacial patient[76]

A certain percentage of maxillofacial patients along with the defect they may have had pre-existing psychological impairments that may further confound their treatment. Others may have been psychologically stable before the event that created the "loss" but afterwards experience some measure of psychological instability

Acquired defects

Patients with acquired maxillofacial defects have had ablative cancer surgery or severe trauma. Patients with smaller defects frequently will be more demanding and have higher expectation than patients with larger, more debilitating defects. The trauma patient is usually younger than the cancer patient, particularly if the trauma is self-inflicted. With the self – inflicted trauma patient, there is a la belle indifference demeanor when confronted with the upward struggle of multiple, difficult surgical procedures to restore the patient's face.

Congenital defects

Those patients with maxillofacial birth defects intuitively understand that they are different from the norm. Congenital maxillofacial patients

usually face multiple and sequential surgeries, orthodontics, and prosthetic procedures over several years in an attempt to correct their defects. Craniofacial anomaly patients are at risk for learning disorders and for internalizing and externalizing behavior problems.

Developmental defects

The developmental defect patient may display emotional responses similar to the patient with congenital defects. Because the developmental defect patient is one in whom the defect becomes apparent over time, the patient may or may not learn to deal with the evolving process.

Reactions of other people

The most commonly reported response of other people to facial disfigurement was staring at the prosthesis. Particularly when the prosthesis was new or when their loss was relatively recent. This was commonly thought to happen more with children who were seen as unlikely to turn away or feign lack of interest. This was considered to be more acceptable, and easier to cope with, than adults staring.

Own reactions

The initial reactions of the respondents were variable according to whether they had lost a facial part as the result of trauma or disease, or whether the "loss" was congenital. For those who had disease, the initial reaction was often one of relief that the disease had been removed, and it was often viewed as being a life saving experience. The initial reaction was anger that an unexpected amount of tissue had been removed.

Practical issues

Participants spent much time relating particular issues. Maintenance of the prosthesis includes the day to – day routine cleaning of the prosthesis and its renewal when it is no longer functional or no longer matches the skin tones. The patient's partner performed this cleaning, and this was interpreted as a demonstration or acceptance of her disfigurement through sharing the "work" of the prosthesis.[76]

Loss and Grief in maxillofacial defects

Loss

Loss has been defined as “a state of being deprived of or being without something one has had and valued”. Loss includes not only the deprivation of the feature, but also subsequent deprivation of some life experience. Patients will be subject to possible rejection by their community. If patients cannot develop successful psychological and physical coping skills, they may experience severe psychological trauma, even if the loss appears minimal.

Peretz divides loss into four categories: loss of a significant person, loss of a part of the self, loss of material objects, and developmental loss. Loss can be emotionally devastating. It can trigger the fear of death at the deepest level.

Loss of part of the face requires social and psychologic adjustment. The effect of missing a facial part on social interaction acts at 3 levels – intimate relationships, interactions with family and friends appear to require least modification. Interactions with acquaintances and people outside the person’s immediate social circle are marked by a certain awkwardness manifest as “staring”. Reports of Bull and Ramsey who suggest that avoidance was the most commonly observed response to facial disfigurement, including greater social distance and averting the gaze.[76]

The process of understanding their loss is part of a movement toward acceptance of the loss. The process of adjustment to loss is described as following 5 stages: denial, anger, depression, bargaining and acceptance.

Grief

Stages of the grief process include:

Shock and denial: Changes occur in sleeping and eating, often symptomatic of depression.

Guilt, anger, and a search to find ways to discharge the emotional pain: The patient may be subject to possible substance abuse.

Adjustment acceptance and growth: The patient comes to realize that the past had its faults and the future may not be so bad. This stage signals acceptance of the loss, healthy adjustment, and new life patterns. Integration of the prosthesis is possible.

The reaction of grief is an adaptive function " to assure group cohesiveness in species where a social form of existence is necessary for survival". Improper recognition of grieving can create a lack of self – confidence in patients, weaken their sense of self, bring despair, or trigger self – destructive behavior. Grief is the opposite of what is considered to be mental health the ability to cope, to love and to work. Grief can cause physical illness, poor judgment, weakened inhibition, clouded intellect and blurred perception.

Children often grieve their losses openly, and a dominant emotion for children towards a loss is anger. Due to their egocentricity, children can often blame themselves for losses and feel guilty. Improperly discharged, guilt and anger can set the stage for later emotional difficulties as adolescents and adults.

Impact of psychological impairments

The maxillofacial patient's quality of life is obviously impacted, which predisposes him or her to a variety of psychological impairments. The disorders mentioned earlier will have varying effects on the patient's ability to withstand surgical procedures or to accept prostheses. The quality and content of the communication between the prosthodontist and the patient significantly affects the patient's ability to accept the prosthesis and the successful outcome of the treatment plan.

The impact of loss of part of the face and the provision of prosthesis on social functioning was slightly dependent on the nature of the "loss". Those respondents who had a congenital loss reported the least necessity for adjustment, because they were in many ways accustomed to being without their facial part. For those who had lost a part of their face through disease

or trauma, minor adjustments were made in interactions with family and friends, usually requiring them to explain the loss.[76]

CHAPTER 10: THE RADIATION THERAPY PATIENT: TREATMENT PLANNING AND POST TREATMENT CARE

By Dr. Surendra Kumar Acharya

Clinician referral

Family support

Support from family and friends can be a great help in coping with trauma. Patients may feel isolated and lonely. A practitioner should be supportive of the family that surrounds the patient and should provide them with as much education as possible.

Patient – centered treatment planning

Patient centered planning is a highly individualized process designed to respond to the expressed needs and desires of the individual. The individual's choice and preferences should always be considered.

The radiation therapy PATIENT: treatment planning and post treatment care

Treatment rationale

Ideally, the dental examination and necessary dental treatment should be performed prior to the onset of definitive cancer treatment.

It is advantageous for the patient to have a basic understanding of the short and long-term effects of radiation to the head and neck. It should be simply explained depending on the location and size of the treatment fields, volume of tissue treated, and types of radiation employed. The patient will experience, in varying degrees, mucositis, xerostomia and a concomitant change in oral microflora, loss of taste and increased sensitivity to spicy or strong tasting food.

The dentist initial examination must focus on the dental implications of these short and long–term effects.

Dental examination and treatment plan

Restorative Procedures and Dental Extractions

A dental prophylaxis and review of oral hygiene procedures should be accomplished as quickly as possible. Definitive restorations should be placed, and the teeth considered non restorable or salvageable with endodontic therapy should be extracted. The required extractions must be accomplished expeditiously since a healing period of at least 10 days to 3 weeks is essential before radiation treatment begins. Teeth are removed with minimal trauma and the extraction sites be closed primarily.

Periodontally involved teeth exhibiting moderate to severe mobility should also be considered for removal. Because irradiated bone loses the ability to remodel, radical alveolectomies must be considered for those patients who are candidates for removable prostheses. Removal of tori and exostoses will help reduce soft tissue problems and improve the opportunity for prosthodontic success.

Impactions requiring extensive bone removal may take longer to heal and are at greater in risk for infection.

Partially erupted teeth must be considered for extraction, particularly if they have been the cause of previous episodes of pericoronal infections.

Pre-radiation Prosthodontic care

Patients are advised not to wear dentures during therapy. Continuing to wear the dentures may be the source of significant additional mucosal irritation and lead to delayed healing following the completion of radiation therapy.

Dentate patients with metallic crowns or fixed partial dentures in the treatment field may suffer significant irritation to adjacent soft tissue as a result of backscatter. This problem can be minimized with the use of a custom-made, soft plastic stent. The stent should be of sufficient thickness to displace the soft tissue in buccal and lingual directions. In some cases, the patient’s fluoride carrier may be used for this purpose.

Dental management during radiation therapy

Mucositis

Earliest effects of radiation are the development of severe soft tissue irritation or mucositis. As radiation continues, the mucosa may exhibit varying degrees of desquamation and frank ulceration. Resulting pain and dysphagia make it difficult for the patient to eat a well – balanced diet, resulting in significant weight loss. Acute mucositis begins during the second or third week of radiation therapy and subsides within 8 to 10 weeks once treatment is completed. A variety of measures are proposed to help alleviate the patient's discomfort.[77]

Frequent daily cleaning of the teeth with a soft brush and mild–tasting toothpaste, frequent oral rinses with a combination of salt and sodium bicarbonate in water or dilute solutions of hydrogen peroxide and water appear to have a soothing effect on the affected areas and aid in keeping the tissue clean and moist. Other therapies have included rinsing with Benadryl elixirs, sucralfate solutions, and topical anesthetics. The mucosa should be cleansed with either the hydrogen peroxide or salt solution prior to using Benadryl or sucralfate. This helps remove debris and mucus from the wounds and allows the medication to adhere more intimately to the tissues. Topical anesthetics in dilute form effectively reduce discomfort and can be useful during meals.

Loss of taste

This loss occurs rapidly during the first week or two of treatment and in most instances gradually returns to normal once the treatment course is completed. Damage to taste buds and microvilli, disrupted innervation as a result of the radiation, and lack of saliva are possible contributing factors.

Xerostomia and dental caries

Change in the quantity and quality of saliva as a result of radiation have been well documented in the dental literature.[78]

Definitive studies regarding treatment and cause of dental caries in the irradiated patient led to the knowledge that the most effective method of treating this condition was through the daily use of topical applications of fluoride. Both stannous or sodium fluoride have been used in a variety of forms (gels, rinses and toothpastes) with significant success, additional advantage of stannous fluoride is that it has an antimicrobial effect, reducing S.mutans counts. Sodium fluoride, because of its higher pH, is less irritating to compromised soft tissue and is substituted for the stannous form for patients who complain of a burning sensation when using the stannous gel. Gels used with a tray are reported to better cover all tooth surfaces than either fluoride rinses or gels applied with a brush.

Immediately following the initial prophylaxis and before radiation treatments begin, irreversible hydrocolloid impressions are made. Custom trays or carriers, which extend to just below the marginal gingival, are fabricated and delivered, taking care to relieve any areas that may impinge on soft tissue. The edges of the tray should be made as smooth as possible to avoid soft tissue irritation. This is an important step since the patient will be expected to use the carrier during therapy while experiencing severe mucositis.

The patient is instructed to carefully brush his of her teeth. Immediately following brushing, the patient is directed to place a sufficient amount of a sodium or stannous fluoride gel into the tray to cover all tooth surfaces. Once positioned, the tray and gel must remain in contact with the teeth for a minimum of 5 minutes. Additionally, the patient is asked not to rinse the mouth for approximately 30 minutes following removal of the tray.

Saliva substitutes and sialogogues

Dry mouth begins in the first week of therapy and gradually worsens over time. The patient experiences a need to continually lubricate the mouth and is forced to ingest large quantities of fluid to aid in swallowing at mealtime. There is a disconcerting change in eating habits with an increased

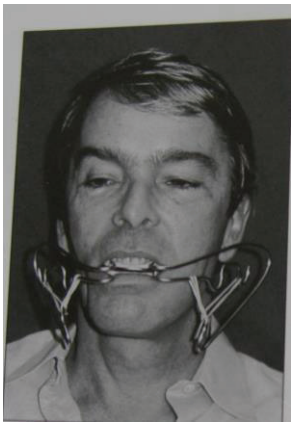
intake of soft, moist foods. Food debris accumulates on the oral mucosa and teeth because of the absence of the self – cleansing action of saliva.

Saliva substitutes have been developed in an effort to alleviate the discomfort and harmful effects of xerostomia. These products consist primarily of carboxymethylcellulose with various salts and flavoring agents added.

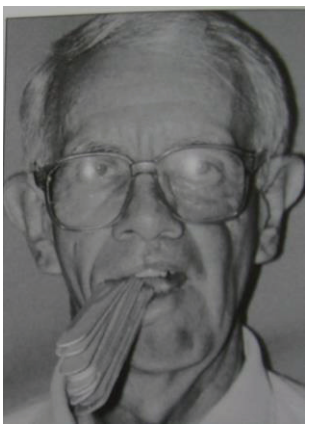
Trismus and Fibrosis

Trismus may begin shortly after radiation begins. Clinically the patient gradually loses the ability to open the mouth. The condition may be exacerbated by surgery prior to radiation and by radiation fields that include the muscles of mastication or the temporomandibular joint. Trismus makes eating difficult and the performance of dental procedures almost impossible.

Primary treatment involves exercising the muscles involved, a variety of bite openers or exercise devices. The simplest and least expensive method of exercising is with the use of tongue blades. A number of tongue blades are placed along the occlusal surfaces of the posterior teeth. The vertical opening is increased as an additional blade is added slowly and deliberately to the original stack. The patient is instructed to pause for a few minutes before placing each additional blade.



Dynamic bite openers



Tongue blades

Shielding and positioning stents

To minimize morbidity associated with radiation to the oral cavity, soft tissue not directly involved with tumor can be displaced or sheilded. The fabrication of one of these stents or splints is time sensitive, since it must be used in the planning of treatment fields.

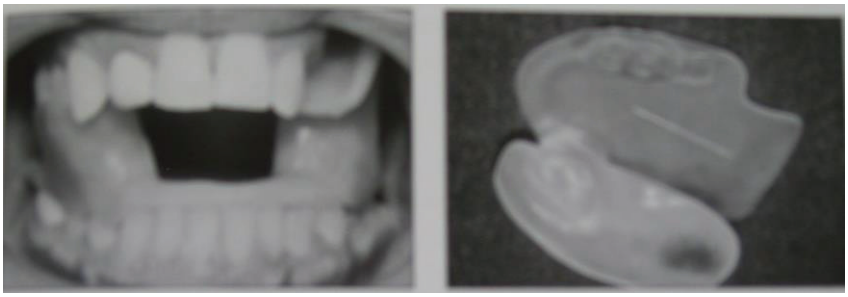
1.Positioning stents

One of the most frequently used positioning stents serves to lower the tongue and places it in a repeatable position during therapy. Since the stent also serves to separate the mandible and maxilla in a open position, maxillary structures such as the palate, upper gingiva, and buccal mucosa are spared radiation effects.

Technique:

Maxillary and mandibular impressions are made with irreversible hydrocolloid. An interocclusal record is obtained at the widest opening necessary to ensure that maxillary structures are not included in the treatment field. Casts are recovered and mounted on a simple articulator. Baseplate wax is softened and placed over the incisal and occlusal surfaces of all the teeth. Two pillars that join the maxillary and mandibular segments and maintain the open interocclusal relationship are fabricated in wax. Two sheets of baseplate wax are then attached to the right and left sides of the mandibular segment. This flat sheet extends posteriorly as far as tolerable, covering the entire tongue and maintaining it in the appropriate treatment position. An opening in the anterior portion of the stent between the pillars acts as a shelf upon which the tip of the tongue rests and serves to help maintain a repeatable tongue position. The waxed stent is evaluated in the mouth.

The waxed stent is flasked and processed in clean, heat – cured or autopolymerizing resin. A length of stainless steel wire is embedded in the horizontal lingual extension. The wire defines the potion of the dorsum of the tongue on simulation films and is of value when planning radiation fields.



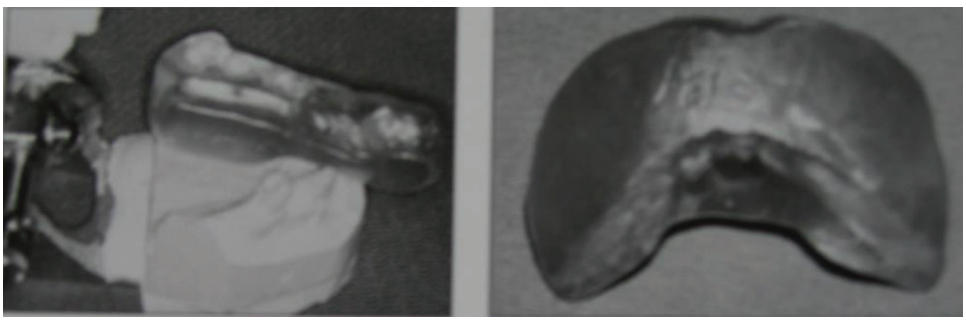
Positioning stent

2.Shielding stents

It is possible when treating tumors of the buccal mucosa, skin, or alveolar ridge with electron beam therapy to protect uninvolved adjacent structures by means of a shielding stent.

Technique:

Maxillary and mandibular impressions are made using a combination of modeling plastic and irreversible hydrocolloid in an effort to displace the tongue laterally. An interocclusal wax record is made in centric relation at a slightly opened vertical dimension. The impressions are poured and the recovered casts are mounted on a simple articulator in the open position. Baseplate wax is placed over the mandibular teeth on the side to be treated, and the articulator is closed to form an index of both maxillary and mandibular teeth. A wax bolus is formed and attached to the occlusal index. The bolus should extend approximately 1 to 2 cm lingually and contact both the palate and the floor of the mouth. The lingual surface of the stent is made as flat as possible. The waxed stent should be tried in the mouth to confirm appropriate extension posteriorly and sufficient displacement of the tongue.



Shielding stent

The waxed stent is flasked and processed in clear, heat – cured or autopolymerzing acrylic resin. The stent is recovered and polished as carefully as possible, making certain that no sharp edges or rough surfaces exist. A recess, extending within 8 to 10 mm of the entire circumference of the stent, is cut into the resin to an appropriate uniform depth dependent on the megavoltage of the electrons to be used. The Cerrobend is heated and the molten metal poured in the hollowed portion of the stent.

The exposed metal is covered with additional acrylic resin to prevent the metal from contacting mucosal surfaces and to minimize backscatter.

Modifications can be made in the basic design of the positioning and shielding stents to accommodate the needs of most treatment situations.

Dental management following radiation

Mucositis and loss of taste

Acute mucositis will subside gradually over a period of 6 to 8 weeks. Healing may be delayed. The length of time necessary for recovery is dependent on the severity of damage to the soft tissue and in some instances may take months.

Xerostomia and Dental Caries

The loss of salivary function is permanent, and salivary flow rates have been proven to decrease with time. Oral tissues will remain dry and uncomfortable, forcing the patient to rinse frequently. Use of saliva substitutes offers some hope. Tooth decay leading to pulpal pathosis can be a serious problem in the radiated patient.

Candidiasis

Xerostomic conditions and the change in normal oral flora are the causes of increased infection. Troches or rinses containing clotrimazole or nystatin are prescribed. Bacterial infections may be treated with appropriate antibiotics. Treatment is continued for a period of 2 weeks. Meticulous oral

hygiene and frequent rinsing with salt and soda or dilute solutions of hydrogen peroxide may have a preventive effect. Soaking prostheses in an antifungal solution or dilute hypochlorite for complete dentures has proven to be an effective preventive measure.

Trismus and fibrosis

These conditions will increase in severity with time, leading to oral openings of 10 to 15 mm. Patients will have difficulty placing dentures or obturators, with resultant compromise in nutrition. The condition is only improved with constant exercise. Exercises should be performed deliberately, followed by periods of rest.

Dental Extractions

Patients receiving cancericidal doses of radiation to the mandibular or maxilla experience diminished ability to heal when even mild trauma causes loss of mucosal integrity and subsequent exposure of devitalized bone. This condition, defined as osteoradionecrosis (ORN). It has been suggested that extremely mobile, periodontally compromised teeth can be safely removed with minimal risk of developing ORN. A conservative approach is advised in regard to extraction of teeth after radiation. Localized periapical or periodontal infection can be managed conservatively with antibiotics, avoiding the immediate need for tooth removal. Teeth located in areas not included in the radiation fields can be extracted safely.

With the use of hyperbaric oxygen, extensive oral surgery can be performed with a substantially diminished risk of necrosis.[79] This procedure, is both expensive and time consuming. Because of a need for specialized equipment and well – trained personals this service is generally available only in major treatment centers.

Hyperbaric protocols involve a series of up to 20 “dives” before and after surgery is a small sealed hyperbaric chamber. Each daily dive is 90 minutes long. The patient must be judged physically and psychologically capable of enduring these conditions.

This procedure greatly reduces the risk of ORN and serves as an important tool in the management of the irradiated patient.

Osteoradionecrosis (ORN)

ORN may result from truama, exposure of radiated bone, and infection. More recently the cause has been related to the hypovascular, hypocellular, and hypoxic conditions that exist in bone following radiation. The type of radiation treatment employed, dosages are contributing factors. ORN is more prevalent in the mandible than maxilla. Improved radiation techniques and better cooperation between dentist and radiation oncologist have reduced the incidences of ORN.

Clinical examination will generally reveal a soft tissue ulcer and an area of exposed bone. Initial treatment should be conservative. The lesion is carefully cleansed and any small, sequestered bony fragments are carefully removed. Oral hygiene procedures are reviewed and the patient asked to rinse frequently with dilute hydrogen peroxide or a salt and soda solution in an effort to keep the area moist and clean. Dentures, if present, are relieved over the affected area, and the patient may be cautioned to use the dentures only while eating. Conversely, it is thought by some that the denture serves to protect the wound and prevent further irritation from movements of the tongue. Soft plastic mouth guards have also been used as protective devices. Topical packing of the area with zinc oxide or various antibiotics has been recommended.

Following initial treatment, the patient is seen at frequent intervals to evaluate the wound and reinforce home care procedures. Sequestra are removed and the area kept smooth to avoid irritation to surrounding tissues. Healing does not always occur with conservative treatment. Pathologic fracture of the mandible may also be a finding. In these situations the patient is referred for hyperbaric oxygen therapy. After the initial series of dives, surgery is performed followed by a second series of dives. Substantial portions of the mandible may be removed leading to discontinuity defects.

Post radiation Prosthodontic Care

Patients treated with radiation are often candidates for new complete or partial dentures. Dentures can be made for some individuals in a matter of 2 to 3 months following radiation with little complication. Conversely, some patients will never wear dentures successfully because of radiation effects.

Dentures should be carefully fabricated using conventional prosthodontic techniques. Plaster or zinc oxide may cause the lack of saliva. Denture border extensions are developed with modeling plastic. This material must be properly tempered prior to placement in the mouth to prevent soft tissue irritation. Soft tissues are manipulated as gently as possible during the impression process. Denture retention may be compromised as a result of xerostomia.

Accurate temporary denture bases are fabricated and interocclusal records made in centric relation at a slightly closed vertical dimension. A closed vertical dimension is believed to place less stress on the alveolar ridges during function and parafunction and may also be an advantage in positioning the denture should trismus or fibrosis develops. Casts are mounted on an articulator, and artificial teeth are set.

The plastic, monoplane tooth is frequently the tooth of choice. A well balanced, noninterfering occlusion is an absolute necessity regardless of the tooth form used. The prostheses are flasked and processed using heat – cured polymethyl methacrylate. Soft materials have been suggested for use as denture bases. The patient should be advised regarding the effect xerostomia and compromised mucosa have on the potential for prosthodontic success and should be cautioned to remove the dentures if any soreness or irritation develops. The patient must be seen at frequent intervals during the first few weeks following delivery of the dentures.

Conclusion

Dental management of the irradiated patient is a serious undertaking since the standard of care certainly has an effect on the patient's quality of life.

CHAPTER 11: IMPRESSION PROCEDURES

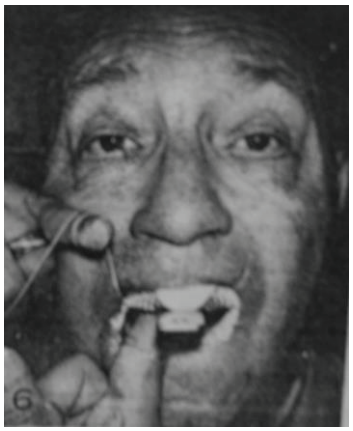
By Dr. Kishore Kumar

Intra oral impression techniques

The materials should be of the best quality and should produce the greatest accuracy with the greatest ease.

Once small defects are found, they should be blocked out with moist cotton or gauze. The gauze or cotton can be lubricated with petrolatum for easier insertion. The small palatal opening threatens to absorb the impression material and leave the prosthodontist with a problem in removing all of the impression material. This difficulty also exists with infants. Accidental intrusion into the nasal-maxillary sinus cavity can be prevented by packing the opening with cotton to which a piece of dental floss has been tied.

The defect may also require some special addition or correction to the impression tray. This is easily done with periphery wax or hard stick compound added to build the try up or out to capture the anatomy as needed.



Intra oral impression technique

Extraoral Impression Techniques

The materials vary according to the end result desired. If great accuracy is needed reversible hydrocolloid or plaster of Paris is best. If the prosthodontist needs good detail quickly, he can use irreversible hydrocolloid or silicone. General contours, but not very much detail, can be obtained with orthopedic plaster bands or impression compound. The model from these two materials can be used to form a lead radiation-protector shield.

Patient Preparation before Facial Impression

Position of Patient: The patient should be either reclined in a dental chair or, better, lying on a table with his head slightly elevated. This position achieves a relaxed muscle tone of the face and easier material application. Also, gravity helps to stabilize the material.

Preparation of Patient: It is helpful and protective if the patient is draped with a sheet and the hair is boxed out by the use of cloth towels. The eyelashes, eyebrows, moustache, beard, etc. should receive a coating of petroleum or cocoa butter as a suitable separating medium. The area of the defect may need undercuts blocked out with wet gauze cotton.

The face or external borders of the defect or that part to be reproduced should be boxed in with boxing wax. This airway can be maintained with straws into the nostrils or mouth or, the impression material can be gently and carefully applied to the nose up to but not including the nares, with a small paint, brush.

Reversible Hydrocolloid

The hydrocolloid can be applied with a small 1- to 2-inch paintbrush to all areas, building up the thickness until the entire surface is covered with at least 3 mm of this material.

Paper clips are bent into an L shape, and one end is imbedded into the hydrocolloid for reinforcement. In approximately 5 minutes, plaster of paris is applied to the area to a depth of ¼ to ½ inch at the borders. This unites the

hydrocolloid via the paper clips to the firm backing of plaster. When the plaster has set and cooled, the subject is asked to wrinkle his face to loosen the impression. The impression, or mask, is then poured into stone to form the moulage.

Irreversible Hydrocolloid

The ratio of powder to water is different. For every scoop of powder, 11/2 to 2 parts of cool water should be used. This enables the material to flow readily into all undercuts and depressions. A second variation in usage compared to reversible hydrocolloid is that it is not applied with a brush; it is poured over the face and pushed or directed to the desired areas with a brush or spatula. After being removed from the face, this impression should be rinsed clean of any debris and immediately poured up, using stone or another material of choice.

Plaster of Paris

This age-old material gives excellent accuracy of slight facial defects, in moulages before and after orthodontic treatment or before and after plastic surgery. It is not to be used when the defect is fresh, bleeding or large, or where deep undercuts exist and need to be reproduced. The material should be more thinly mixed than for intraoral use, to increase the flow and adaptation, plaster of paris is painted on the face. Glycerine as a separating medium is applied to the plaster mask before the model is poured.

Orthopedic plaster Bank

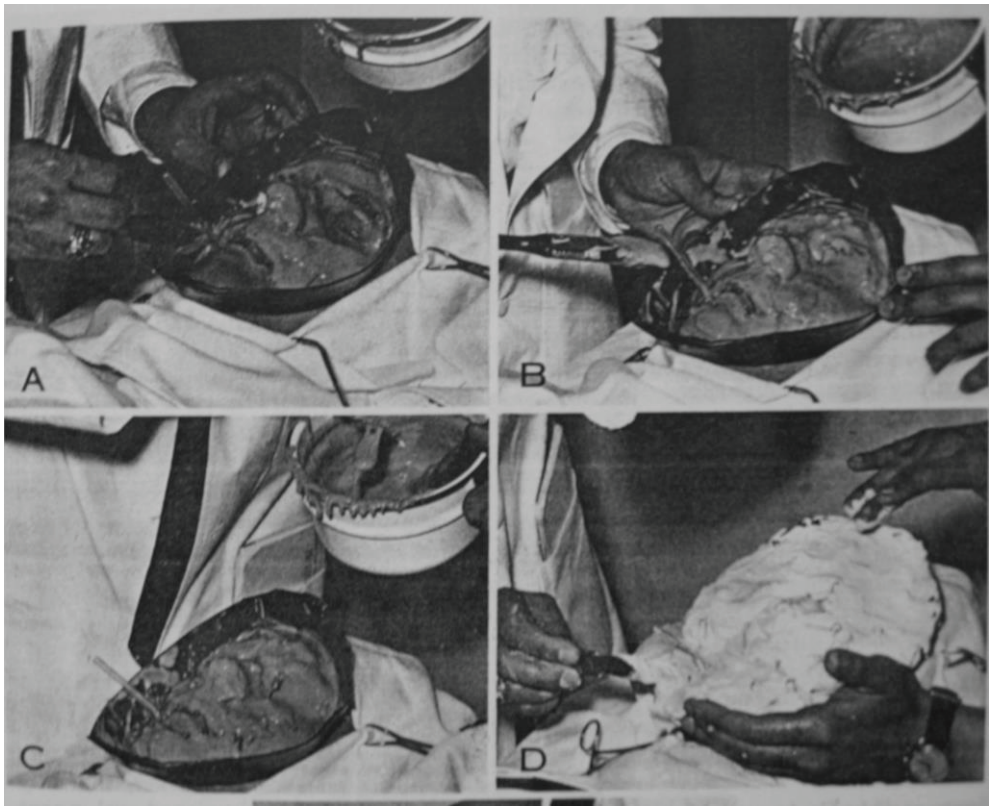
The pieces are cut to the width of the face while they are still dry. These are dipped in water and positioned over the lubricated face. Once set, the rough mask is removed and painted with a separating medium of glycerin or petrolatum before being poured in stone.

Impression Compound

This thermoplastic material is best used for a rapid but rough impression, which is to be poured only once. After several cake of compound (three to five) have been warmed and tempered, they are flattened in the prosthodontist's hands to the approximate size of the facial area and laid over this area. Then the compound is pressed lightly to conform to the face.

Silicone

Room temperature-vulcanizing (RTV) silicone is an excellent material for obtaining a clear, detailed reproduction of the face. This material is more expensive to use than any other. However, many pours can be made if needed, and it can be stored easily with little deformation or distortion.



A. Thin layer of impression material applied to the face
B. L-shaped clips added
C. Whole area ready to receive plaster of paris
D. Plaster applied

CHAPTER 12: RETENTION OF PROSTHESES

By Dr. Desh Deepak

Intraoral Prosthesis and Its Retention

a. Anatomic retention

Intraoral retention includes the use of both hard and soft tissues, i.e, teeth, mucosal and bony tissues.

Anatomic undercut areas may be found in the palatal area, cheek, retromolar, labial, septal, posterior nasal pharyngeal, or anterior nasal spine areas. Large alveolar ridges and high palatal vaults provide more retention than flatter ridges.

Additional aids to anatomic retention include proper occlusion, proper post dam, and surface adhesion.

b. Mechanical Retention

i. Temporary Mechanical Retention: Some wire clasps come preformed and can be readily incorporated into the acrylic palate of an obturator or saddle in a lower prosthesis or a previously existing denture. Preformed stainless steel wire clasps include Adams, Arrowhead, Akers, Roach, or Hawley labial wires.

Preformed stainless steel bands or crowns may be adapted to a child or adult to increase retentive form of a mutilated or conical tooth. Extra soldered lugs or bands with prewelded brackets can be used to provide undercuts on these crowns for better clasps retention.
An old denture can be wired in place to obturate a maxillary hemisection.

ii. Permanent Mechanical Retention: The properly designed and fabricated clasp will provide stability, splinting, bilateral bracing, and reciprocation, as well as retention.

1.Reciprocating Clasp Arm: It is usually more convenient to locate the retentive undercut on the buccal surface of the abutment tooth. Reciprocation then is accomplished via a guiding plane opposite the retentive undercut on the abutment tooth in combination with a more rigid clasp arm on the direct retainer.

2.Occlusal Rest: This part of the direct retainer is that unit of the partial denture frame designed specifically to fit within a prepared rest seat in the abutment tooth.

Firtell measured the influence of a simulated obturator on the amount of force required to dislodge a simulated unilateral removable partial denture with various clasp designs. The presence of an obturator reduces the retentive capability of a removable partial denture. Lingual retention seemed to provide more resistance to displacement than buccal retention. Infrabulge clasp designs seemed to be more retentive than suprabulge clasp design.[79]

King further expounded on the indications and rationale for using cast circumferential and wire clasps for obturator retention. This article justly recognizes that obturator retention is multifactorial and that an understanding and application of basic fundamental prosthodontic principles and clinical judgment are necessary.[80]

MacEntee presented the use of nonrigid attachments placed on select teeth for added stability and retention of a maxillary denture combined with a nasopharyngeal obturator.[81]

3.Prefabricated Precision Attachments: The attachments can be placed into cast crowns for the best in esthetic and mechanical retention.

These preformed attachments are most useful in rehabilitating cleft lip and cleft palate cases. They can be used with or without a reciprocal arm.

4.Semiprecision Attachments, Custom-made: This attachment is formed in the wax pattern, using a specially shaped mandrel mounted on the parallelometer. A reciprocal arm is always necessary.

5.Snap-on Attachment: This is also a preformed precious metal precision piece designed to retain and to stabilize prosthesis. A Baker bar or Anderson bar is the rod connecting two abutment crowns, and the clasp engages this rod.

This attachment is usually used in combination with other retentive means such as a clasp, precision attachment, or thimble-telescoping crown.

6.Overlay (Telescoping) Crown and Thimble Crown: This is often used when an overlay denture is planned or an extremely malposed tooth is needed for stability but is not considered for orthodontia. It is also used when a major change in the vertical or centric dimension is indicated, as in cleft lip-cleft palate, prognathic mandibles or resected mandibles.

7.Magnets: Manetized metal discs in denture teeth or magnetized metal rods can be inserted into the edentulous ridge and the overlying saddle extension or can be easily inserted into the dentures themselves.

8.Gate Type or Swing Lock Device: This retentive aid helps gain partial retention for many loose or periodontally involved teeth. This retentive means can be used when most other methods are ruled out.

9.Intermaxillary ‘‘George Washington’’ Springs: These come preformed and can be inserted into an upper and lower set of dentures to help stabilize them on the ridges during function.

10.Auxiliary Retentive Devices: These include buccal-lingual continuous clasp, valve seal, fouchard wing device for clefts, guide planes, surface adhesion, and denture surface adhesion devices such as porcelain and Durabone.

11.Screws: These are specially made custom parts.

12.Implants: Implants include tantalum tray, acrylic mandible and wire, and intraosseus wire.

13.Suction Cups: Inflatable balloon suction cups are used for maxillary resection.

14.Adhesives: These become necessary to aid retention when the surgical wound is large, the palate is flat, the anterior- posterior lateral septal wall is not undercut but rather angles away from the natural palate, the maxillary tuberosities are nonexistent, the soft tissue undercuts in the area of surgery are missing, or the patient's salivary flow is diminished due to pre and postradiation therapy.

Commonly used adhesives are categorized as; rubber – based liquid adhesives (natural and latex), pressure – sensitive bifaced tape, silicone, acrylic resin emulsions (gum mastics), and cyanoacrylates.[52]

Pressure sensitive tape (double – coated polycethylene 3M surgical tape)

These materials are backing strips composed of cloth, paper, film, foil, or laminate coated with a pressure – sensitive adhesive. The adhesive is a rubbery type elastomer combined with a liquid or solid resin tackifier components, plasticizers, fillers and antioxidants. Two advantages of tape are the ease of application and cleaning after removal. The primary indication for biphasic tape is with materials that have poor flexibility and nonmobile tissue beds.

Silicone adhesives (Hollister)

These adhesives are a form of RTV silicone dissolved in solvent. Despite their low adhesive strength, they have good resistance to moisture and weathering with low water sorption. They are prone to dissolving in organic solvents such as xylene.

Acrylic resin emulsions (Epithane – 3 ProsAide)

These adhesives are composed of acrylic resin dispersed in a water solvent that, when evaporated, leaves a rubber – like substance. Materials within the mixture include synthetic rubber, vinyl acetate, reclaimed rubber, vinyl chloride, styrene, and methacrylic. Some problems associated with adhesives are as follows:

1. Patients with poor manual dexterity or coordination may not be able to apply the adhesive or position the prosthesis in a consistent manner
2. Margins adjacent to mobile tissue may require constant reattachment with facial movements.
3. Allergic or irritational responses may persist.
4. Poor hygiene may limit the wearing of a prosthesis because of interference with adhesive qualities.
5. Some aromatic base adhesives may curl thin prosthesis margins.

Routine removal of adhesive also may remove the external pigmentation.

The choice of a skin adhesive involves the status of the tissue and the material of the prosthesis that it contacts. Some adhesives bond more strongly with certain materials. Udagama determined the best combinations to be polyvinylchloride with Epithane – 3 adhesive acrylic with Medico, and polyurethane with Davol.

Krill's findings are as follows:
Silicone adhesive type B (aerosol) is the most effective for silicones.

Pressure – sensitive tape is the most effective adhesive for polyvinyl chloride.

Butyl alpha – cyanoacrylate is the most effective adhesive for polyurethane as tested for the Initiation of Peel test and Silicone Adhesive Type B for the Peel Effort test.[52]

The testing of biphasic tape was performed by Polyzois who measured the tensile bond strengths of five silicone facial elastomers to skin by use of five double – sided adhesive tapes. Significant differences were observed among the various silicone tape combinations. Cosmesil and MDX 4-4210 elastomers had the trongest bond to skin with most adhesive tapes, whereas Silskin II, Cosmesil HC2, and RS 330T-RTV were the weakest.[52]

Primers were introduced as a material to aid in the improvement of bond between silicone and other prosthetic materials such as polyurethane liners. Wang evaluated two primers, three polymerization methods and seven primer reaction times to determine the conditions for optimum adhesive bond strength. Bond strengths were significantly greater for polyurethane treated with primer 1205 rather than S-2260 regardless of the polymerization method or primer reaction time.[82]

15.Occlusion: The proper cusp height and fossa depth as dictated by a healthy mandible and temporomandibular joint could also assure denture stability and retention.

Extraroral Retention

a. Anatomic Retention: Use of both hard and soft tissues of the head and neck area. Retention of the dynamic extraoral area depends on many factors for a successful end result. These factors are related to the location and size of the defect, tissue mobility or lack there of, undercuts, and the material weight of the final prosthesis.

Hard Tissues: Act as a base against which to set the prosthesis and to provide a better seal of the prosthesis with the use of an adhesive.

b. Mechanical Retention: Use eyeglasses as an indirect mechanical retention, which at the same time hides the margins of the prosthesis.

1.Parr discussed the use of retaining a facial prosthesis by attaching the prosthesis to eyeglasses, which can then be attached to the ears. This "piggy back" method is also used more thoroughly with combination prostheses situations.[52]

2.Magnets: These may be embedded in a nasal prosthesis or orbital prosthesis to help secure it to a maxillary obturator.

3.Snap Buttons and Straps: These are also used on a large extraoral prosthesis.

4.Adhesives: The adhesives aid in retention, marginal seal, and border adaptation. This secures the prosthesis against accidental dislodgment.

Combination of anatomic, mechanical and adhesive retention: Large facial defects use all means of retention.

The range of retaining prostheses is wide. Facial prostheses and combination intraoral – extraoral prostheses are the two situations that require the most attention. Much effort is placed on the improvements of adhesives and the use of intraoral and extraoral implants. Parel discussed the decreasing dependence on adhesives for retention of facial prostheses. Good communication with surgeons regarding essential tissue removal for the purpose of optimal esthetics and retention of prostheses has influenced this decrease in adhesive use.

CHAPTER 13: CLEFT LIP AND CLEFT PALATE REHABILITATION

By Dr. Amar Kumar

Introduction

The cleft lip and palate deformity is a congenital defect of the middle third of the face, consisting of fissures of the upper lip and/ or palate.

Numerous classifications are given. The method proposed by Stark is the most widely used today, with that proposed by the cleft palate association next common in usage. Stark's method divides the middle third of the face into primary (anterior) and secondary (posterior) palates at the incisive foramen, with the upper alveolar arch being a component of the primary palate. They can be either unilateral or bilateral and complete or incomplete, with varying degrees of incompleteness. Variation of cleft lip presents with a Simonart's band, which is actually a partial fusion of the lip, usually at the base of the nose. The remaining tissues of the philtrum and lip in the cleft area are open. In the bilateral cleft lip situation, one side may be completely cleft while the other side is incomplete.

In the Stark classification, a cleft of the secondary palate is not complete unless it extends to the incisive foramen. A rather common form of incomplete cleft of the secondary palate is the submucous cleft, in which the mucous membrane is intact on both the oral and nasal surfaces, but there is failure of bone and muscle fusion in the midline.

Veau classification:

Type1: defect of vermilion or red portion of the lip

Type2: clefts that include the vermilion and a portion of the lip musculature up to but not including the floor of the nostril on the affected side

Type3: unilateral complete clefts involving the full thickness of the lip typically accompanied by a marked deformity of the nose;

Type4: bilateral clefts of the lip either partial, complete, or in combinations.

Gillies and Fry realized that cleft palate involved more than just the failure of embryological processes to unite and that there was also a deficiency of tissue. Thus, the forced apposition of the remaining segments, followed by inappropriate surgery, would produce a maxillary arch deficient in both horizontal dimensions and restrict the downward and forward growth of the third of the face. The solution offered by Gillies and Fry was a combination of surgery to repair the soft palate and the provision of a prosthesis to close the remaining hard palate defect.[83]

The patient with cleft of the primary and secondary palate presents a complex biologic, sociologic, and psychologic problem, one whose best management involves several disciplines. The team approach is the only effective one, with the members usually including the pediatrician, plastic surgeon, pedodontist, otolaryngologist, and social worker.

Diagnosis and treatment planning

Congenital cleft can easily be diagnosed by visual examination, with radiographic and speech procedures supplying additional details concerning the deformity.

Congenital clefts should be differentiated from acquired defects caused by disease or injury.

Impressions for study casts:

Infants

Adapt a piece of baseplaste wax against the maxillary or mandibular ridge. The wax is held with one finger and molded against the tissue with the other fingers.

The wax pattern obtained is invested and processed in acrylic resin. Holes are drilled in the tray to provide mechanical retention and escape ways for impressions. The maxillary impression is made with the infant's head tilted at a downward angle of 15^0. The head is tilted slightly upward for the

mandibular impression. While the impression is being made, at least four assistants should be available to:

Hold the infant's head,

Depress the tongue and hold the suction,

Hold the infant's body and feet, and

Mix the impression material.

Older Children and Adults

A stock tray of adequate dimensions is selected. If a registration of the entire cleft is desirable, the stock tray is modified with modeling compound extending posteriorly to the postpharyngeal wall. This added section to the tray is underextended about 4 to 5 mm in all directions, leaving an adequate space for impression material. The fast-setting, irreversible hydrocolloid is used for registering the preliminary impression.

Treatment planning:

Should consider both the cranial-facial growth and behavior of soft and hard tissue both before and after surgery.

Indications for prosthesis in unoperated palates

1.wide cleft with deficient soft palate

2.wide cleft of hard palate

3.neuromuscular deficiency of soft palate and pharynx

4.delayed surgery

5.expansion prosthesis to improve spatial relations

6.combined prosthesis and orthodontic appliance

Indications for prosthesis in operated palates

1.an incompetent palatopharyngeal mechanism

2.surgical failures

Contraindications of prosthesis

1.mentally retarded patient

2.uncooperative child or uncooperative parents

3.rampant caries

Palato-pharyngeal function

This term relates to the co-ordinate movement of the palate and the lateral and posterior naso – pharyngeal wall, which is so important in speech and the initiation of swallowing. A cleft soft palate is not simply a divided anatomically 'normal' palate: more of the fibres that would be inserted into the aponeurosis have to find alternative, ectopic insertions. Palatopharyngeus, palatoglossus and levator palate fibres are attached to the posterior aspect of the residual hard palate, insertions that extend forward along the margins of the cleft palatal shelf to form the cleft muscle of Veau, and are important in designing retention into any cleft prosthesis.[84]

The most widely appreciated feature of the cleft palato pharyngeal mechanism is passavant's ridge, first described in 1869. Passavant belived that this ridge or pad, to be seen standing out from the lateral and posterior pharyngeal walls in a cleft palate subject, was part of the normal mechanism revealed by the presence of the cleft. He attributed the phenomenon to the contraction of superior constrictor fibres, which triggered a lengthy debate in the 19th century German literature with the proponents of palatopharyngeus fibres as the causal mechanism.[83]

There are two principal patterns of attempted palato-pharyngeal closure identified endoscopically so far as pharyngeal wall movement is concerned. With both, the soft palate is drawn superiorly and posteriorly but in one the posterior and lateral pharyngeal walls form a passavant ridge, while in the second there is narrowing of the pharynx due to medial movement of the lateral walls.[83]

The important feature when moulding the speech bulb is that muscular activating during swallowing is relatively slow and forceful compared to the rapid and slight pharyngeal movements associated with speech.

For maximum efficiency, the bulb has to be of the smallest bulk and positioned to take maximum advantage of naso-pharyngeal wall movement.[83]

Prosthodontic consideration in the management of surgically compromised cleft palate patients

Cleft palate surgery should restore a functioning anatomy that improves speech, oronansopharyngeal physiology and esthetics without interfering with form and function.

Prosthetics may be necessary in patients with (1) surgically redivided palates, (2) nonfunctional pharyngeal flaps, (3) large or multiple perforations, and (4) palatopharyngeal insufficiency and/or incompetency after surgical repair.[14]

Surgical redivision of palate

Harkins et al suggested that redivision of the soft palate is necessary if surgery results in

1. Multiple perforations in the palate usually along the suture line,
2. Extensive cleft areas separated by bands of soft tissue,
3. Heavily scarred palatal vault that restricts oral space and necessitates placement of a prosthesis at a level inconsistent with comfort and efficiency, or
4. Limited mobility of palatal muscles, which may displace a speech aid prosthesis.

A repaired cleft palate should seldom be redivided to aid in construction of speech aid prosthesis. It might be considered when large perforations separated by narrow bands of nonfunctional tissue hinder proper placement of the pharyngeal section of speech aid prosthesis.

In the child with a surgically redivided palate, speech aid prosthesis can be constructed by fitting stainless steel bands with retentive lugs to the maxillary first molar teeth. The palatal portion of the prosthesis is processed in heat cured acrylic resin and the pharyngeal section fabricated by using techniques described for obturator construction in unrepaired cleft palates.[14]

Soft palate perforations

Presence of a soft palate perforation along the site of the original cleft represents failure of surgical closure. The most common causes are (1) inadequate approximation of the opposing surgical surfaces, (2) closure under tension (wide cleft), (3) infection, (4) improper suturing, and (5) traumatic disruption of the healing wound.

The symptoms associated with these perforations vary with size and location. A perforation large enough to permit food and liquid to enter the nose during swallowing is disturbing for the patient.

The location of the perforation also influences prosthodontic management. If the perforation is located close to the area of maximum soft palate elevation, placement of the pharyngeal section through the perforation with the soft palate remaining inferior to the speech aid prosthesis is less than advantages.

Prosthodontic management may be the initial treatment of choice in patients who develop large post surgical fistulae. These patients might also be considered for redivision of the palate to permit better prosthodontic management.[14]

Palatopharyngeal insufficiency and incompetency after repair

The soft palate section of the prosthesis must often be placed inferior to the obturator to circumvent the soft palate and position the obturator at the proper superior-inferior level. This type of prosthesis can also be used with neurologic deficits secondary to repeated surgical procedures.

Surgical redivision of the soft palate with removal of the levator veli palatine muscles as an aid to construction of a pharyngeal obturator is contraindicated. Surgical redivision with removal of the levator muscles prevents subsequent surgical procedures and commits the patient to a prosthesis for life.[14]

Savion describes the technique of fabricating a feeding obturator for a preterm baby.

Neonates born with a cleft palate have difficulty eating, which may lead to failure to thrive. The oronasal communication diminishes the ability to create negative pressure, which is necessary for suckling. To compensate, the baby presses the nipple between the tongue and the hard palate to squeeze out the liquid, but this mechanism is insufficient if the cleft is wide and the nipple gets trapped inside the defect. The feeding process is also complicated by nasal regurgitation of food, excessive air intake that requires frequent burping, and choking.

There are different approaches to address the problems associated with feeding cleft palate babies.

The feeding obturator is a prosthetic aid that is designed to obturate the cleft and restores the separation between the oral and nasal cavities. It creates a rigid platform toward which the baby can press the nipple and extract milk. If facilitates feeding, reduces nasal regurgitation, reduces the incidence of choking, and shortens the length of time required for feeding. The obturator also prevents the tongue from entering the defect and interfering with the spontaneous growth of the palatal shelves toward the midline. It also helps to position the tongue in the correct position to perform its functional role in the development. The obturator reduces the passage of food into the nasopharynx, reducing the incidence of otitis media and nasopharyngeal infections.

Technique

1.To create a preliminary impression tray, cut a piece of light-polymerizing acrylic resin to the approximate size of the hard palate. Use a finger to insert it into the baby's mouth and press the material over the hard palate and into the buccal and labial vestibules. Remove the material and light-polymerize it extrorally.

2.Examine the tray introrally and identify areas that it does not cover. Add strips of the light-polymerizing acrylic resin to those areas; remove the tray and light-polymerize it extraorally. Verify that the tray covers the hard palate and extends into the vestibule as much as possible. Add a small handle to the tray to make it easier to manipulate.

3.Load the tray with a thick mix of tissue conditioning material and insert it introrally, while the baby is held face toward the floor, in order to prevent aspiration in the event of vomiting and asphyxiation due to airway obstruction.

4.Pour the impression in type III dental stone to fabricate a custom impression tray from light-polymerizing acrylic resin. Place the posterior border of the tray between the hamular notches. Do not attempt to include the cleft area of the soft palate. Extend the borders into the vestibule and add a handle.

5.Evaluate the impression tray intraorally. Determine the easiest path of insertion, paint vinyl polysiloxane adhesive over the intaglio surface, and load it with viscous vinyl polysiloxane impression material. Insert the loaded impression tray into the mouth while holding the baby, face toward the floor. Monitor the baby's oxygen level throughout the impression making process to prevent accidental hypoxia. Ensure that the baby is making suckling motions, for this will create the desired border molding and ensure the baby' s ability to perform nasal breathing.

6.Box and pour the impression in Type V dental stone.

7.Inspect the definitive cast for significant undercuts in the cleft area. If these exist, block them out with wax before fabricating the prosthesis. Paint separating medium over the surface of the definitive cast and use the salt and pepper technique to fabricate an acrylic resin prosthesis.

8.After retrieving the prosthesis, verify the existence of uniform thickness and smooth any sharp edges. Finish and polish the prosthesis. Create a small hole suing a round bur at the labial flange and attach a ligature to facilitate easy retrieval of the prosthesis a ligature to facilitate easy retrieval of the prosthesis by the parents.

9.Evaluate the intaglio surface of the obturator intraorally for excessive pressure areas, using a disclosing material and adjust accordingly.

10.Instruct the parents and care givers on how to insert, remove and clean the prosthesis. Instruct them to use the obturator during feeding time, remove if afterwards, and thoroughly clean the baby's oral cavity and cleft a soft cloth soaked in warm water.[47]

Some have suggested using thermoplastic materials, but those materials must first be heated and softened, then inserted into the patient's mouth and molded to the desired form. The inherent problems with these methods are the danger of inflicting thermal damage upon the delicate soft tissues of the newborn and the locking of the impression in the nasal cavity. The use of light – polymerizing acrylic resin overcomes these problems.

A variety of impression materials were used for the purpose of obtaining a definitive impression, including alginate, beeswax, periphery wax, adaptol, citricon, polysulfide impression material, and very high consistency vinyl polysiloxane. The putty – type vinyl polysiloxane is the material of choice because its high viscosity reduces the danger of aspiration or swallowing, and its relatively good detail duplication is satisfactory for the purpose of fabricating of palatal prosthesis.

If more retention is necessary, it is possible to use denture adhesive or to engage the undercuts within the defect with resilient denture liner.[47]

PROSTHODONTIC REHABILITATION FOR CLEFT PALATE PATIENTS

Goals

To improve appearance and

To provide adequate function, including an adequate speech mechanism.

At birth, certain variables can exert a profound influence on the result obtained with these patients. Some of these variables are as follows

1. Length of the minor segment
2. Position of the minor segment
3. Position of the anterior portion of the greater segment or of the premaxilla
4. Degree and location of the apparent tissue deficiency
5. 5.Area of coverage or extension of the appliance
6. Growth potential of the patient
7. Appliance design: active or passive
8. Parent management of the child and appliance and degree of cooperation.

These can be reduced to configuration and extent of the cleft, growth potential of the patient, parental cooperation, and appliance design.

Presurgical orthopedics in cleft patients

The early orthodontic treatment of patients with alveolar cleft was demonstrated by Burston as early as 1965 and was expanded later. O'Donell et al presented an analysis of the subject of presurgical orthopedics in the treatment of unilateral cleft lip and palate in 1974.[52]

Various forms of presurgical orthopedic appliances

1.Passive or holding appliance

2.Pin or screw retained appliance

3.Active or expansion appliance

The type of appliance to be placed will be determined by the configuration of the cleft. If any degree of collapse is manifested, an expansion appliance is placed. If the collapse appears to be primarily in the anterior region a fan type of split acrylic appliance is used. If it appears that the arch is collapsed throughout its length, a straight jackscrew appliance is used.

If the cleft configuration is wide or if the segments appear in an ideal relationship, a holding appliance is used. In cases of arch collapse, surgical closure of the lip is delayed until the expansion appliance has achieved an ideal arch configuration. Cases presenting initially with an ideal arch alignment or with a wide cleft configuration are operated on as soon as the holding appliance is placed.

The primary purpose of the appliance prior to lip closure is not to proliferate tissue or initiate growth but to guide the maxillary segments into proper spatial position with each other and with the mandibular arch. After the maxillary appliance has the segments in good alignment, the plastic surgeon restores lip continuity.

Success in achieving and maintaining a good arch alignment is considerably greater in patients whose initial arch configuration is wide.

1.Passive appliance

The appliance typically involves the use of single acrylic base plate that passively covers the lateral alveolar cleft segments while the uncovered premaxillary segment is moved so as to be in as proper alignment as possible with lateral segments through the use of external strapping. The patient is evaluated weekly for soft tissue irritation and guided movement of alveolar segments, which

is accomplished by selective additions and removal of acrylic from the appliance. Premaxillary movement is accomplished by varying the amount and direction of forces placed on the external strapping. This procedure depends greatly on the compliance of the caretakers of the infant and the retention of the appliance is often poor.

2.Pin – retained appliance

A pin – retained appliance was introduced by Hagerty in the way of an expansion bar of stainless steel (only), in which the pointed ends were inserted into the palate bone for increased retention. Hagerty later added an acrylic base to the expansion bar. The method that is still in use currently was introduced by Georgiade et al in 1970 with a staple pin made from stainless steel wire for retention of acrylic plates that would cover the palate. In 1976, Latham et al presented an extraorally activated expansion appliance for cleft infants. This appliance contains an extraoral control knob that facilitates activation of the expansion bar, which leaves the anterior cleft regions free for premaxillary movement and clinical evaluation. Rapid expansion can be accomplished easily. Retraction of the premaxilla in a bilateral cleft lip and palate is accomplished by external strapping or an orthodontic elastic chain attached to a pin that penetrates the vomer. Varying the forces on the elastic chain guides the premaxillary movement. Latham et al reported that it makes approximately 1 day for the vomer to respond to the force and pull into the midline. Once inserted, the expansion screw is then turned one – half revolution per day (or on alternative days), which can be accomplished by the parents. Each revolution provides 1 mm of expansion at the anterior ends of the expansion arms. Alignment of the alveolar segments takes approximately 3 to 5 weeks. When the alveolar segments are properly positioned, the surgeon removes the appliance and repairs the cleft lip either immediately or 2 to 3 days later.[52]

3.Active appliance

Nasal and alveolar molding procedure involves reducing the size of intraoral alveolar cleft and active molding and positioning of the nares tissues. The infant wears a palatal appliance until the alveolar segments are

in a more favorable position. As material is selectively added to and reduced from the intaglio surface of the appliance, alveolar segments are molded to a more normal position that ultimately facilitates surgical repair of the lip. Once the alveolar segments are approximated, a nasal stent is added to the appliance. The purpose of the nasal stent is to support and shape the dome of the nares and adjacent cartilages.[52]

Advantages of presurgical nasoalveolar molding

Controlled and predictable positioning of the alveolar segments is achieved without the need for lip adhesion surgery or more invasive surgical placement of pin – retained appliances.

Presurgical nasoalveolar molding allows the surgeon to perform a gingivoperiosteoplasty and reduces need for extensive tissue dissection for widely separated alveolar segments. Santiago et al in 1998 presented that in more than 60% of the cases studied, this therapy has reduced the need for secondary alveolar bone grafts in children of mixed dentition**.** Wood et al in 1997 presented that midfacial growth is not adversely affected by this therapy.

Presurgical nasoalveolar molding has reduced the need for bone grafting of the alveolus in later childhood and reduced the need for early nasal revision surgery.[52]

One area of concern is the parental management of the child and the maxillary appliance. Passive appliances need no parental control, but active appliance can present problems because they must be activated by the parents to make the segments move. When the child has come home from the hospital, the parents must see to it that he wears the appliance at all times. If the appliance is left out of the mouth after lip closure, lateral collapse of the segments can occur within 24 hours, creating enough change so that inserting the appliance after that time will not be effective because it no

longer fits. Consequently, new models are needed to make an appliance that will fit the collapsed arches.

Another time of concern is the eruption of the maxillary first deciduous molars. The appliance must not impede eruption of the teeth. Therefore, if the first deciduous molars erupt and displace the appliance, the chance for segment collapse is good, unless proper adjustments are made in the appliance.

If the parents activate the appliance without regard for fit, the expansion creates a dislodging force for which the parents compensate by adding more adhesive to the appliance. At the next appointment the prosthodontist sees an appliance, which is too big for the segment relationships. The appliance is then reduced to its original position for a fresh start.

Children learn that removing the appliance attracts attention and they do so frequently, thereby reducing its effectiveness.

Loss and breakages can also allow collapsing changes to occur if the parents do not call immediately for an appointment to rectify the problems.

Dorf et al says that early prosthetic management of cleft palate is better by giving articulation development prosthesis**.**

Most children who undergo early palate repair parallel their noncleft peers in articulation development. In contrast, children who undergo palate repair at 18 to 24 months of age or later demonstrate an 80% to 90% incidence of abnormal articulation.

Regardless of the timing or type of palate closure, however, all treatment must seek optimal results in appearance, palatal growth and development, and speech development.

Because of the relationship between early palate repair and significantly improved articulation development, early prosthetic management for improved articulation development appears to have potential benefits when early surgery is not planned.

This type of obturator attempts to create a more normal oral anatomy and simulate palatopharyngeal valving for proper articulation development. Although it may resemble orthopedic and / or feeding prosthesis, this prosthesis has been designed and evaluated for articulation development.[84]

Prosthetic Speech Appliance for Children

Three types of speech aids can be constructed for children:

1. An obturator with a palatal-velar-pharyngeal portion
2. A baseplate type which functions to obturate the palate and helps speech
3. An anterior prosthesis, which contours the upper lip and improves the anterior occlusion.

The first type is used for training, diagnosis, and as a temporary appliance. It is used to promote increased muscular activity so that the coordinated movement of the soft palate and the posterior pharyngeal wall will achieve velopharyngeal closure during speech. The pharyngeal bulb is actually undersized to promote activity of the muscles involved in proper velopharyngeal closure.

For children from 3 to 9 years of age construct stainless steel crowns or bands on the second deciduous maxillary molars and the deciduous maxillary cuspids. To these crowns are soldered labial and buccal protuberances. These protuberances act as retentive areas for the wrought wire clasps, which are fabricated with the speech application.

The completed bulb must have a surface with an individualized configuration that will act within the nasopharynx to allow complete

veopharyngeal closure during speech and yet present an open velopharyngeal port for breathing.

The bulb section is fabricated in the patient's mouth by starting with a small bulb about the size of a pea. With each addition of compound head is bent down as far as the child can. This action brings the spinal column forward, causing the posterior pharyngeal wall to indent the posterior surface of the impression.

The child next moves his head from side to side, which cause the palatopharyngeus muscle to trim the anteriolateral aspect of the bulb.

For larger defects, the tray should only be loaded to record the margins of the defect when the denture impression is taken – just sufficient detail for the palate to be correctly contoured and wire loops to be added to retain the functional impression of the defect when the denture has been completed. Smaller defects need to be packed with a ribbon of gauze impregnated with soft paraffin to prevent impression materials with low viscosity passing through and forming a mushroom in the nasal passages that cannot be removed when set.

The supporting loop needs to be directed towards the anterior tubercle of C1 when the denture base is seated, the correctly positioned loop (and subsequently the obturator) will appear to lift well into the naso-pharynx above the cleft soft palate. After this, the appliance is removed and the necessary laboratory procedures are performed to convert the compound bulb into a permanent one of acrylic.[83]

The preliminary bulb only helps to build up tolerance for the patient as he learns to wear the speech appliance. The child should be allowed to adjust as he will to the appliance, but he should not be given a basis for feelings of fear or defeat.

The usual retentive crowns are placed, the maxillary impression is obtained, and the hard palate is fabricated in about the same way as the hard palate portion of a temporary speech appliance.

Mandibular prognathism is often seen at ages 9 through 14 as a result of sudden growth of the mandible without comparable growth of the maxilla. An anterior prosthesis will restore function to the mandibular dentition and create a pleasing profile. It will also rebuild the needed arch form and supply tooth replacements for normal articulation and mastication.

Minsley determined the effect of speech aid prosthesis on resting breathing. Nasal cross sectional area was measured during inspiration and expiration in eight cleft palate patients. The measurements were made for the unobturated defect during both phases of respiration and then repeated while the defect was obturated by a speech aid prosthesis. The results of the study revealed that the presence of a speech aid prosthesis significantly decreased the cross-sectional area less than $0.40cm^2$ with concomitant impairment in nasal respiration when the speech aid prosthesis was present in the oral cavity. The data suggest that the design of these prostheses should account for breathing requirements as well as for speech.[20]

Most individuals with cleft palates have an impaired nasal airway. The presence of septal deformities, turbinate hypertrophy, and maxillary growth deficits tend to reduce the size of the nasal airspace and produce some degree of oral breathing.

Hairfield et al found that approximately 80% of the cleft palate population mouth breathe to some extent. Warren et al reported that surgical and prosthetic correction of the cleft palate defect might further compromise the nasal airway.[20]

Hairfield et al demonstrated that in normal adults there is a phasic difference in nasal size between inspiration and expiration. That is, the nasal cross-sectional area was found to be larger during inspiration than during expiration ($0.63\ cm^2 \pm 0.17$ during inspiration and $0.56\ cm^2 \pm 0.14$ during

expiration). On the other hand, in cleft lip/palate subjects Warren et al noted that in some instances the nasal value collapses during inspiration and is blown open during expiration; a phenomenon opposite to what Hairfield et al reported in normal adult subjects.[20]

Oburators to supplement short palatal repairs

Small naso-pharyngeal obturators may be requested following soft palate repair for a number of reasons:

As a diagnostic procedure to test if pharyngoplasty might subsequently help when initial repair has left a short soft palate.

The patient may decline further surgery while still anxious for speech improvements. The surgeon feels that the vascular supply has been compromised following previous multiple interventions and that further surgery would be counter-productive. The speech and language therapist wishes to undertake a programme of obturator bulb reduction as an aid to active therapy. [83]

Palatal training appliances and supports

The loop of training appliance (PTA) is contoured to the resting soft palate. It is used as an adjunct to speech therapy in situations where there is habitual lifting of the soft palate by the tongue, so- called tongue humping. The PTA is thought to function by placing a barrier between the dorsum of the tongue and the palate to reinforce exercises. The device has also been recommended to help prevent drooling when a patient has suffered a stroke by creating an awareness of the palate and stimulating swallowing.[83]

Management should, ideally, begin early and be part of the overall team approach to the care of these patients, with good oral hygiene and dietary advice being given to parents at the outset, and thereafter continually reinforced. This was emphasized by Rivkin et al.[85]

Case reports of treatment selection and their successes

I) Overdentures

Duthie – reported on multiple retained teeth, which were crowned and used to retain and support an overdenture.

Koomen – used gold thimble crowns with telescope insertions within the overdenture to aid stability and retention

Vojvodic and Jerolimov – described gold thimble crowns, telescope inserts and precision attachments to increase stability and help retention of overdenture.

The principle of retention / preservation of hard and soft tissues and the use of whatever teeth remained are emphasized by these authors. This is in keeping with reported beneficial effects of the decreased levels of ridge resorption by the retention of roots.

II) Resin bonded splint / attachment (S)

Morikawa et al – Used a cast metal frame covering the occlusal aspect of posterior teeth and palatal aspects of anterior teeth to support an acrylic obturator within a small palatal defect.

Cohen et al - reported a resin bonded metal frame to which an acrylic element was attached via a pin locking mechanism.

Ali and Lock – described a metal bonded frame to which teeth and flange of acrylic were attached via precision pin mechanism.

III) Fixed Bridges(s)

Gold and Pruzansky – described the use of multiple unit bridges (6 – 10 units) to replace missing lateral incisors and stabilize the maxillary arch.
Carl – reported large fixed –fixed bridges 6+ units to replace missing lateral incisors and stabilize the maxilla

IV) Partial dentures

Hochman et al - outlines the use of anterior milled crown to increase the retention of a partial cobalt chrome denture to replace a missing lateral incisor.[85]

Ohyama in a review paper suggested one tooth each side of the cleft would be suitable to be used as abutments for fixed restorations and to prevent segment collapse. On occasions he stated it was necessary for two teeth, including the premolars on the side of the smaller maxillary segment to provide adequate stability**.** [85]

Ramstad and Jendal, who observed 22 unilateral cleft lip and palate patients, reported a long-term evaluation of stability of maxillary segments. The patients at age 18 years were fitted with a fixed prosthesis (a fixed – fixed bridge from the central incisor to canine on the cleft side) and followed up over a 13 year period. Whilst they identified errors in their photographic recordings the report concluded that a mean change in transpalatal width of – 1.3 mm at the canines – 2.4 mm at the first premolar site and – 2.8 mm at the first molar site were acceptable.[85]

Nicholson and Plint reported rapid maxillary expansion treatment with grafting in the cleft patient is much more stable if a fixed bridge is placed at the cleft site. The provision of a removable appliance leads to eventual relapse of the expansion (they surmised) by the lack of continuous wear and gradual loss of fit and stability.[85]

Prostheses for Adults

Fixed Prosthesis

This type of repair becomes the treatment of choice when the ridge defect is small. A fixed appliance is preferable when stability, longevity, comfort, and appropriate hygiene can be accomplished. Often a separate removable framework is necessary after the anterior restoration is completed to carry the bulb into the pharyngeal area.

The cuspid teeth, which are stable and on either side of the free-floating premaxilla and the remaining sound teeth in the premaxilla are each reduced for placement of veneer crowns. After the crowns are constructed, an impression is made in order to replace any missing teeth and to solder together the crowns into a fixed appliance. This method allows the prosthodontist to restore the integrity of the maxillary dental arch and to provide the needed dental facial esthetics, in addition to stabilizing the premaxilla for adequate dental function.

A removable prosthesis is preferred when there is a large anterior ridge defect and/or the middle third of the face is depressed. These prostheses can be further categorized into (1) snap-on type and (2) non snap-on type.

Snap-on Prosthesis with No Speech bulb

Often, with a V-shaped ridge defect it may be necessary to remove poorly shaped and poorly positioned teeth. These patients may be wearing a temporary acrylic appliance. The abutment teeth need to be properly prepared for full coverage either with anatomically carved crowns or thimble crowns and a Baker, Dolder, or other type of bar splinting one side with the other.

A gold framework is designed and cast to overlay the bicuspids and clasp the molars; the clip attachment engages the anterior cross-arch bar.

Removable Partial Prosthesis with No speech Bulb

With a large ridge defect and extremely poor occlusion, more teeth may be salvaged to increase the retention and stability of the superimposed denture. This prosthesis restores the vertical, facial, and occlusal dimension of the maxillofacial deformity.

Complete Superimposed Denture With No Speech Bulb

The overlay denture restores the vertical dimension of the face and gives an ideal arch form to the maxillary arch with a full complement of teeth.

Snap on prosthesis with speech bulb

A modern, permanent adult speech appliance has the palatal portion attached to the velar portion. The pharyngeal section should be high so as to prevent interference with tongue movement and also to keep the bulb small. This will result in a bulb that weighs less but still uses the maximal activity of the pharyngeal musculature. If the bulb is placed low, it might interfere with tongue movement during speech and swallowing.

This appliance snaps to the bar; overlays the bicuspids, which are out of occlusion, thus gaining stabilization from them; and brings the anterior teeth forward to help correct the middle face concavity.

Conventional Speech Prosthesis with Bulb

Patients with a full complement of teeth may need only a framework clasping the healthy abutment teeth. This framework carries the palatal, velar, and pharyngeal portions necessary for speech improvement.

Complete superimposed Denture with speech bulb

Another type of prosthesis used by the cleft palate patient is the overlay denture, which may or may not have a pharyngeal bulb section.

Unconventional speech Aid prosthesis

The appliance for the patient was made in two sections so that patient could insert the nasal portion above the palatal shelves, using the undercut created by the right and left palatal bones. Proper use of these shelves gives additional stability and retention to the finished appliance. The patient then inserts the denture portion of his appliance. The nasal portion and the denture portion of the appliance interlock by means of the gold button placed in the denture.

Fundamental ideas in treating cleft patients:

1. When impressions are made of the soft palate and tissues, the impression materials must not displace the nasoparynx.
2. The bulb and tailpiece (velar and pharyngeal section) of the prosthesis must not be displaced by velar muscle movements or by tongue movements during speech and swallowing.
3. The nasopharyngeal tissues must be in contact with but must not be displaced by the bulb of the appliance during speech and swallowing.
4. When the pharyngeal section of the prosthesis has been properly extended, the patient should have no nasal emission during speech, and his control of the air stream and nasal resonance should be within normal limits.

The ultimate outcome of any speech appliance will depend upon:

The attitude and auditory acuity of the patient.

The patient's ability to change and create new motor skills needed for proper utilization of a speech appliance.

The ability of the posthodontist to create a speech appliance.

The ability of the speech pathologist to teach the patient how to sue to speech appliance.

CHAPTER 14: REHABILITATION OF MAXILLARY DEFECTS

By Dr. Amar Kumar

Most common of all intraoral defects are in the maxilla in the form of an opening into nasopharynx. The prosthesis needed to repair the defect is termed as maxillary obturator. Primary goal is to close the defect and separate it from sinonasal cavity.

At the age of 67, Dr. Frued developed squamous cell carcinoma of right maxilla and he underwent many surgeries for that. Extreme trismus complicated the construction of prosthesis and so he named it as “The Monster.”

President Cleaveland underwent resection of left maxilla distal from cuspid and included anterior portion of soft plate. The definitive and surgical prostheses given to him were successful. So from above it is said that the degree of malignancy, the propensity of recurrence of tumors in this region will vary the acceptance and effectiveness of the prosthesis.

Maxillary Vs Mandibular defects:

	Maxillary	Mandibular
Quality of Rehabilitation	Can be restored close to normal function and appearance.	May show functional disabilities & cosmetic disfigurement. So this may effect the quality of life.
Mode of rehabilitation	Easy and simple	Follows long unpredictable course,requiring team effort
Effectiveness of rehabilitation	Post surgical complications like hypernasal speech, fluid leakage are eliminated after obturation. Radiation therapy has less impact on	Rarely achieve normal physical and psychological function.

	maxillary structures.	
Reconstructive surgery	Not indicated	Mandibular defects are dependent on effectiveness of surgical reconstruction.
Private practice	Can be managed	Needs team effort
Psychosocial profiles	Patients are younger and have dentition in better condition, demonstrate higher socioeconomic levels with less tobacco and alcohol abuse.	

Definition:

An oburuator (Latin obturare: to stop up) is a disc or plate, natural or artificial, which closes an opening.

A prosthesis used to close a congenital or acquired tissue opening, primarily of hard palate &/or contiguous alveolar structure.

Functions

It can serve in lieu of a levin tube for feeding purposes

Keeps the wound or defective area clean.

Enhances the healing of traumatic or post surgical defects.

Helps to reshape and recontour the palatal countour.

Improves speech.

Esthetics – can be used to correct lip/cheek position.

Reduces the flow of exudates into mouth.

Benefit the morale of the patient.

Used as a stent to hold dressings or packs post surgically.

Obturators: Congenital defects

Acquired defects.

Congenital Defects: 3 types

A simple base plate type that helps to correct swallowing, feeding and speech. It also restores hand plate defects.

An oburator with tail consisting of speech appliance, which restores soft and hard palate defects.

Overlay or superimposed denture

Acquired defects

Immediate temporary \ surgical obturator

Temporary \ Treatment \ Transitional

Permanent obturator

Evolution of obturator framework design was given in 2003 by Parr and Gardner: [5]

Before 1530 Petronius described use of cotton wool, oakum, wax for stuffing of acquired palatal defects for obturation.

AmbrosePare, a French surgeon, brought awareness and use of prostheses in rehabilitation of disabled and disfigured case which significantly advanced the development of maxillofacial prosthesis during 16th century. Around 1530's Pare described palatal obturator buttons retained by pieces of sponge or metal in the manner of cuff link.

Search for better materials and improved means of retention was advanced in 18th century by Fauchard who using metal created the prototype of maxillary major connector for used in replacement of natural teeth.

He described the prosthesis with wings that are placed form oral side of obturator and made use of floor of nose for retention He also used ligatures affixed to natural teeth for retention of and obturator.

In 1757, Bourdet suggested that silk ligatures attached to natural teeth could be used to support a less bulky sheet metal cover to obturate the defect. These did not include artificial teeth and were constructed for small perforations of hard palate.

Le Mannier in 1764 performed first operation for cleft palate. In early 19th century this procedure was reintroduced by Roux and Warren.

Delabarre in 1820 made two major contributions. First- the inadequacy of weak silk ligatures for retention was recognized. A new concept of wire connecting the obturator with laterally placed metal bands that clamped on teeth was introduced.

Second - design and fabrication of first artificial velum. He introduced the movable velum concept. This called for activation of a hinged elastic prosthesis extension by the tongue to simulate soft palate function. Since the prosthesis replaced entire hard and soft palate, it was bulky and was retained by spiral springs anchored to metal frame that rested on natural lower teeth.

Snell in 1823 first utilized a cast for the construction of gold-plate obturator to which rubber flaps was attached with a gold hinge. Prostheses of this period were mainly for restoration of speech rather than function or appearance.

The development of vulcanite rubber by Goodyear in 1855 coupled with clinical efforts of Stearns resulted in improved design. He recorded palatopharyngeal function with soft wax carried on a stick. From this a wooden mold was then carved in which rubber was vulcanized.

Dr. Norman Kingsley recognized the merits of Stearns prosthesis and sought to simplify the applications of hinged obturator by reducing the complexity. He also recognized the significant physiologic differences involved in treating an acquired defect as compared with congenital defect.

In 1867, Suersen proposed a new system for obturator design and construction utilizing a fixed obturator concept. He used wire loop posterior extension shaped by using warm guttapercha.

Suersen's work was soon enhanced by Passavant's observation that a shelf like soft tissue projection extended anteriorly from posterior pharyngeal wall during phonation. This is called Passavant's ridge that served as a posterior inferior landmark for determination of obturator extension in oronasopharynx.

Fitzgibbon in early 20th century proposed entirely metallic obturator prosthesis to replace ill fitting, irritating, debris gathering, and fluid absorbing soft-hinged obturators.

During 19th century a variety of splints and stents were designed to assist the healing of traumatically induced wounds and bony fractures.

Kazanjian suggested that metal splints were used as early as 1780 and noted that prosthetic appliances could be used to immobilize fractures prevent adhesive and cicatrization resulting from facial injuries.

Claude Martin in late 19th and early 20th century described extensive prostheses with both intraoral and extra oral components. Many of his creations were placed immediately after surgery, so he has been credited with "immediate insertion" idea.

Ferguson described the maxillectomy procedure in 1846.

Esser reported the use of an epidemic inlay of skin in the mouth for reconstruction of hard and soft palate in 1917.

Acrylic resins –20th century – shifted the emphasis from denture base resin using, based on an empirical carved form to a more customized, controlled precise type.

Fry in 1927 stressed the importance of co-operation between surgeon and prosthodontist and the advantage for pre op consultation in the management of patients undergoing reconstructive treatment.

Hans Pichler in 1929 used skin grafts, which were retained by immediate prosthesis that prevented shrinkage and helped to provide a more cosmetic result.

Although vulcanite was a relatively stable and more workable material it lacked good hygiene and esthetic qualities. For either introaral or extraoral prostheses, rubber was durable but not easily revised or repaired nor colored.

In 1973 Bulbulian and Clarke introduced the use of prevulcanised latex for pliable prosthetic facial restorations. This material was lighter and many multiple hollow prostheses were cast from an original plaster cast. It was not durable and color was not permanent.

After worldwar II more ideal materials like plastisols, organisols, plastigels, elastomers, silicone rubbers, and thermoplastics came into service. PMMA replaced vulcanite because of its improved esthetics and ease of manipulation. Disadvantages are prostheses were not easily duplicated, extrinsic coloring was difficult, thin margins were sharp and could irritate soft tissues.

1953 - formation of American Academy of Maxillofacial Prosthetics.

Andrew Ackerman in 1953 reported use of various prostheses for patients with mandibular resection.

In 1978 Aramany provided a classification system of obturator defects and framework design for each. This provided impetus for rapid refinement of obturator framework designs, retentive capacities of various clasp designs, occlusion and general effectiveness of obturation and its effect on oral function.

EDENTULOUS MAXILLECTOMY PATIENT

Surgical obturator:

Use of an immediate surgical obturator is less common because of invasive method of securing the prosthesis.

The importance of a surgical obturator prosthesis, which is placed immediately during the maxillectomy procedure inside the operation room, was proved by a retrospective study. In 23 maxillectomy patients the immediate placement of surgical obturator prosthesis was compared with the delayed placement in terms of patient outcomes. For 17 patients, surgical obturator prosthesis was placed immediately as part of the operative procedure, and for 6 patients, an occlusive dressing only was placed. The group with surgical obturators progressed more quickly and had a more rapid return to normal function. The authors concluded that the immediate surgical obturator prostheses for maxillectomy patient are beneficial.[52]

Procedure:

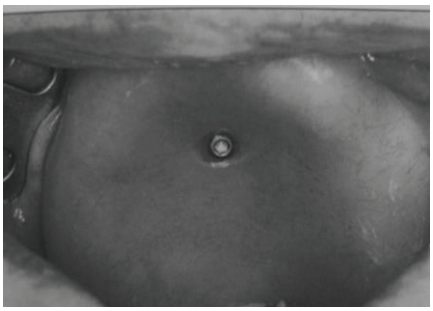
An alginate impression of maxilla is made. Casts are retrieved. The surgical outline is marked on the cast and if any tumor bulk present on the alveolus or hard palate, is reduced to normal contour. The prosthesis can be fabricated with auto polymerizing or heat polymerizing resin. Heat processed one is not needed since it is only for 7-10 days. Composite resins are convenient but quite brittle. They can fracture with placement of wires or screws.

Bone screw retention: placed in palate and is angled posteriorly.

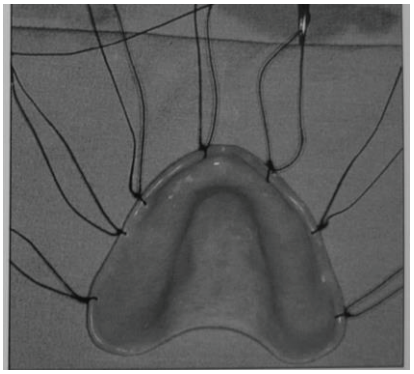
Suture retention: placed at periphery of prosthesis

Circumzygomatic retention: this technique is invasive and has greatest morbidity when removing wires. It is not commonly used.

Use of existing denture: there will be occlusal discrepancies since it cannot be placed in the same way as before surgery.



Bone screw retention



Suture retention

Delayed surgical obturator:

Given 7-10 days post surgically. This is the treatment of choice in edentulous patients with extensive defect.

An alginate impression is made after the packing is removed. The procedure must be carefully done when the area is raw and tender. Prosthesis is made as described previously. As healing progresses posterior occlusal ramps are established since posterior occlusion helps the patient retain the prosthesis in position.

Alternative: Diagnostic casts are made prior to surgery. Post surgically the surgeon outlines the surgical margins on the cast. Prosthesis is made and on the day the packing is removed, the prosthesis is delivered and adjustments are made.

Interim obturator:

Baseplate used for surgical obturator can be border molded and relined on remaining hard palate. The prosthesis is seated with each increment of material and impression is made to capture a few mm at a time. This incremental shaping creates a hollow, light prosthesis.

Technique:

Patient movements, speech and swallowing are evaluated during border molding:

Performs exaggerated head movements turning right to left with neck flexed and extended. The mouth should be opened and closed, mandible moved laterally and asked to swallow.

Peripheries of bulb portion will be 2-3 cm in height. There is no need to fill the entire space since it adds weight and offers little border seal.

Superior area of defect contracts between visits and creates a dislodging force on the prosthesis.

Inferior aspect should be at the level of original hard palate and soft palate junction. If it extends below the palatal plane then:

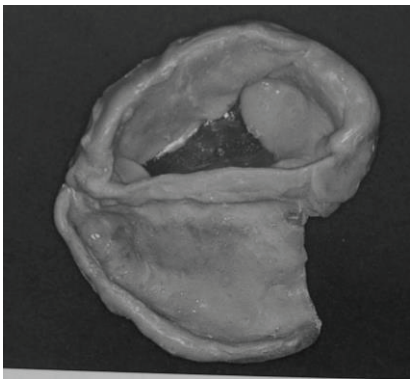
1. Space required for tongue function is violated. With speech and swallow the prosthesis is dislodged into defect by tongue.

2. The injured soft palate junction will contract and elevate back to the level of hard palate very rapidly over next two weeks and if periphery of prosthesis is lowered- it irritates the tissues.

Hypernasal speech occurs due to loss of air form oral cavity into nasal cavity. As the prosthesis periphery is sealed, air loss will diminish and speech becomes normal. Analysis is to listen to ‘m’ and ‘b’. If ‘b’ is clear there is no air escape. If it cannot be distinguished that means these is air escape, so a slight addition of material at junction of soft palate is needed.

Insertion: After impression is made with reliner, it is flasked and the prosthesis is fabricated. It is given on same day otherwise tissue edema will occur and the defect will change rapidly after removal of the packing. Delivery should include a functional impression with tissue conditioner since it allows better assessment of functional movement.

Interim prosthesis requires several revisions after surgery. Over extensions may occur due to tissue changes and need to be corrected.



Interim obturator

Definitive obturation: done after 3-4 months.

A definitive prosthesis is not indicated until surgical site is healed and dimensionally stable and the patient is prepared physically and emotionally for restorative care.

Reasons for new prosthesis:

1. The periodic addition of interim lining material increases the bulk and weight of the prosthesis and this temporary material may become rough and unhygienic.
2. If anterior teeth are resected, addition can be of psychological benefit.
3. In retention and stability are inadequate, occlusal contact on the defect side may result in improvement.

Retention of complete denture in maxillary defects is compromised. Air leakage, poor stability, reduced bearing surface will compromise adhesion, cohesion and peripheral seal. The contours of the defects must be used to maximize retention, stability and support.[86]

Maxillary obturator in edentulous patients will exhibit varying degree of movement depending on amount of contour of remaining hard palate, size, contour and lining mucosa of defect and availability of undercuts.

Axis of rotation:

Edentulous patient with total maxillectomy defect - axis of rotataion is along medial margin of defect. Portion of obturation most distant form this axis will exhibit greater degree of motion.

Anterior defects- axis of rotation is along posterior margin of defect.

Remaining palatal structure: Arch form, the amount of palatal shelf remaining and character of residual alveolar ridge influence stability and support for the prosthesis.

Square or ovoid arch will exhibit more palatal shelf area than tapering arches following total maxillectomy.

In square arches the palatal shelf is perpendicular to direction of occlusal stress and provides more support.

The defect: engagement of skin graft and scar band formed at skin graft mucosal junction will improve retention significantly. Since lateral portion of obturator exhibits the greatest degree of movement, retention can be improved by appropriate obturator- tissue contact superolaterally.

Additional retention can be gained by extending into the nasal aperture.

	DENTULOUS	**EDENTULOUS**
Support		
From residual structures	Number,position and location of natural teeth	Anteroposterior and mediolateral size of ridge crest are directly proportional to amount of support.Broad and flat palate-high support than high tapering one. Slope of soft palate.

From the defect	floor of the orbit, nasal septum [for small defects],pterygoid plate & infratemporal fossa.	

Retention

From residual structures	Intra coronal retainers.	proper border seal: related to contour and size of residual structures and to size and location of the defect.
Form the defect	Hard palatal shelf, residual soft palate, lateral scar band, anterior nasal aperature.	

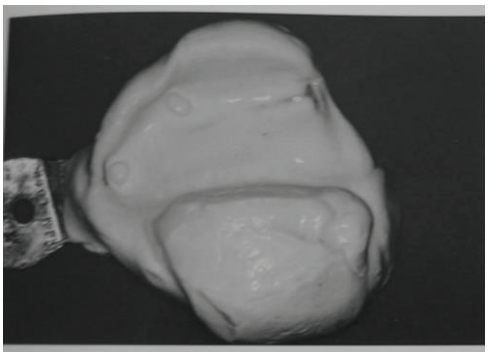
Stability

From residual structures	Maximum bracing components.	Arch form- square forms are more effective than tapering/ ovoid Maximum extension over supporting areas.
From defect defect are	structures discussed for support and retention within the contacted	
Occlusal stability	Defective contacts are to be avoided. Group function should be considered.	Balanced occlusion.

Less vertical displacement with a given horizontal flexure with a higher lateral prosthesis wall. That is vertical extension of lateral wall of prosthesis improves retention.

Preliminary impression:

First block the fistulas and undercuts with piece of cotton or gauze tied with floss extending out of the mouth. An impression is made with alginate in a stock impression tray. Interim prosthesis can also be used as a tray.



Preliminary impression

Final impression:

Custom acrylic resin tray is made such that it extends 2-3 cm into the cavity. Undercuts are to be blocked on cast while making custom tray. This serves to stabilize and orient the tray to the defect. Next palatal margin is developed. Superior height of this extension should terminate at junction of oral and respiratory mucosa. Next the soft palate is molded. While molding all eccentric movements are performed to account for movement of anterior border of ramus and coronoid process of mandible. Impression is made with elastic impression material. If soft palate exhibits elevation during speech and swallowing- a functional impression is made with wax.

Leubke describes a sectional tray for use in patients with trismus.[87]

Beumer et al advocate a method in which impression is refined with modelling plastic, a soft flowing wax and an elastic impression material to record the defect.[2]

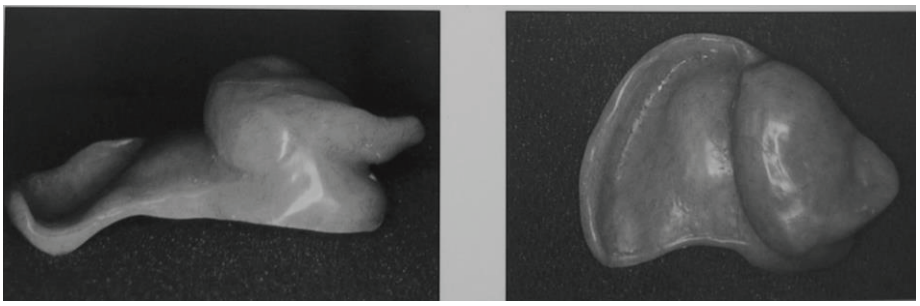
Carl indicates the need for adhesives and undercuts that add additional alignate to a set impression when needed.[88]

Schmaman in 1992 describes foam impression technique: [21]

Primary impression is made with alginate. Special tray is made and a mushroom shaped acrylic resin retention- relocating button is added to tray. Silicone impression material is loaded on to tray excluding the button and impression is made in normal manner. It is removed checked and replaced. Modified disposable syringe is loaded with silastic foam liquid and catalyst and is mixed. This is inserted into the defect through nostril. After setting tray is removed and relocating button is withdrawn from extremely elastic foam. Foam impression is removed by pushing it downward through nostril and this is relocated on button. Advantage-removed from undercuts, disadvantage -fast setting.

Jaw relation records

Processed record bases are ideal. Because of missing structures and unusual reconstruction, retention and stability are compromised.



Processed record bases

Conventional methods are used in determining vertical dimension. In the extreme trismus cases vertical dimension must be reduced to allow the passage of food between denture and teeth.

CR is recorded with soft wax, Zoe paste, and plaster. Graphic tracings are contraindicated since, even though maxillary record base exhibits stability, pressure on the defect side will result in some displacement into the defect and compromise the accuracy of the recording. Retention and stability of record bases are critical to obtain an accurate maxillomandibular relation.

Klein and Coffield described use of tissue conditioning material or acrylic resin liner, which bonds to acrylic resin base material and engages available undercuts within the defects.

Hiroshi Murata describes a technique using silicone soft reliners:

On master cast undercuts are blocked. Self-cure is placed along the walls of defect and remaining palatal portion of cast. Coat the resin with petrolatum. Place putty or clay material into the defect and fabricate lid for the defect. Remove clay/putty from defect and lute lid to the obturator making a lightweight hollow bulb record base. Now add silicone resilient liner material to obturation section and to borders. Do not coat the record base with primer. Insert record base in mouth; close seating of record base with resilient relining material allows stable record base and accurate record. After registration is completed, peel off the lining material.[89]

Occlusal scheme: Non-anatomic posterior teeth are preferred.
All records are verified at try in stage.

General considerations concerning bulb design given by Chalian:

It is not needed in surgical or immediate temporary prosthesis.

It should not be so high as to cause eye to move during mastication.

Should always be closed superiorly.

Should not be so large as to interfere with insertion if mouth opening is restricted.

Should be hollow to aid speech resonance, to lighten the weight on unsupported side and to act as a foundation for a combination extraoral prosthesis in communication with intra oral extension.

An open or topless bulb is unhygienic, foul smelling and unpleasant for the patient to tolerate.

Techniques for hollowing an obturator:

Classic technique is to grind out the interior of the bulb after processing while monitoring the thickness of walls. Once hollow, lid is fastened to the superior border.

Parel and La Fuente used cellophene and sugar to make hollow obturator.

Elliott used clay and cellophane paper.

El Mahdy and Guelde used two flasks with interchangeable parts.

Silicone rubber foams and polyurethane foams were used as obturating agents.

Worley and Kniejski used asbestos.

Schneider used crushed ice.

Chalian, Barnett and Fayttore et al used double flask technique.

All these have disadvantages: they are complex, self cure is used to repair the obturator, seepage of saliva when it is not completely sealed, uneven thickness of obturator as obturating materials deforms under pressure of flask closure.[90]

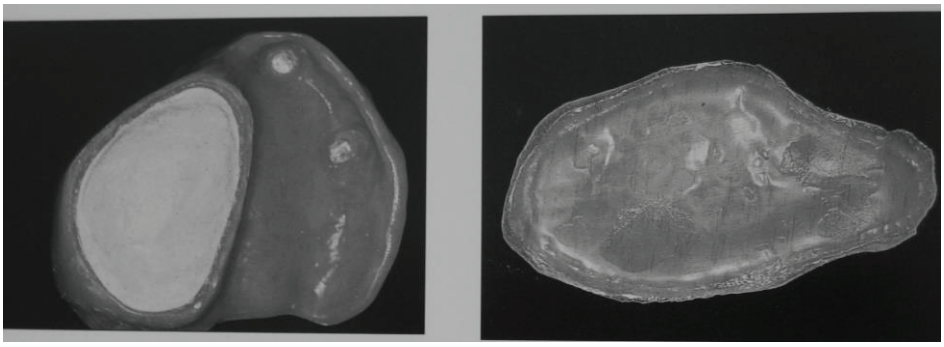
Procedure for two-piece hollow obturator:

Wax up of master cast includes defects area, base, medial, posterior and lateral walls keeping palatal side open. Modeling clay is filled in defect area, false palate and ridge are shaped and contoured in clay, leaving 2mm thickness for wax pattern on reshaped palate. Tin foil is placed over modeling clay; next the false palate and ridge are waxed. The waxed lid and tin foil are separated. The two portions are flasked separately; boiled out and processed with heat cure resin. They are deflasked. The margin of lid portion is perforated or undercut for retention and then two parts are joined by self-cure.

It is important that obturator is not placed in warm water or a pressure pot during curing Heat will cause the gas inside the bulb to expand and push through the seal, creating a hole. A pressure pot will cause the gas to shrink creating a suck in defect that will disrupt the bulb's seal

Avoid methods that contaminate acrylic resin (melted sugar) or incorporate foreign bodies into prosthesis (wire mesh) to support the lid.

Paprocki et al used wet cotton rolls, plaster and pumice mix to fill the defect creating a shape for lid. Foil is placed over this plaster. A sheet of triad is cut to fit on the foil and is cured in light unit. The plaster is removed, the lid is placed and a thin strip of triad is positioned over the finishing and cured. It is finished and polished.[91]



Plaster and pumice are used to create the shape of the lid

Lid

Fabrication of hollow obturator using PVS putty material:

Warm the baseplate wax and wax up over remaining ridges, palatal structures and lateral walls of the defect. Block undercuts also. Pour a stone core short of oral cavity. Mix putty and adapt it on stone core, shape it to the palatal form, allow it to set to form the lid. Remove the set putty. Bend die pins at 90 and place them into holes drilled in the stone core with cyanoacrylate. Flask the lid and waxed cast separately. Boil out both; the waxed cast is held in lower part of the flask while the die pins hold the stone core in the upper flask. Both are packed with heat cured acrylic and cured deflask. Both are packed with heat-cured acrylic and cured. Deflask, polish and reassemble the two parts together.[92]

Procedure for one-piece hollow obturator:

The trial denture is flasked and boiled out in the usual manner. A shim is constructed in the following manner: the undercut areas are blocked out and the entire defect area is relieved of 1mm thickness wax. Three stops are placed in the wax to facilitate proper positioning of the shim. 1mm of wax is also placed in top half of the flask over the teeth and palate area to form top wall of shim. A layer of self-cure resin is then contoured over the wax relief in the defect site, with another layer over the wax in the top half of the flask. After curing the flask is opened and wax is flushed off the shim. Heat cure acrylic is placed and pressed to bottom of defect, and the shim is reinserted for final processing. After curing, it is finished and polished.

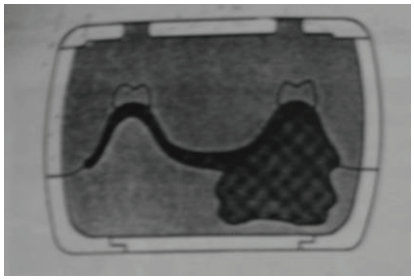
Advantages

1.There are no lines of demarcation on denture to discolor.

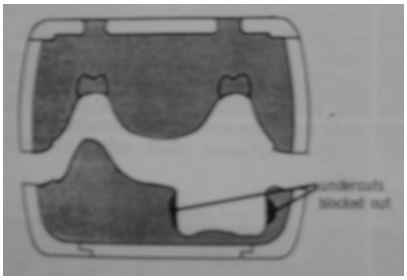
2.The undercut areas of defect are thick enough to allow for djustment.

3.It is simple and consumes less time.

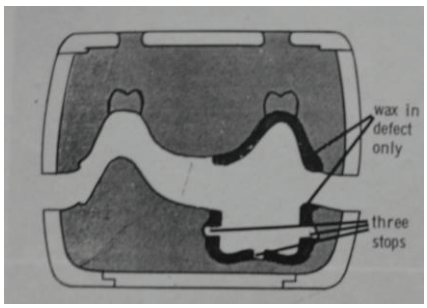
4.Accuracy is assured.



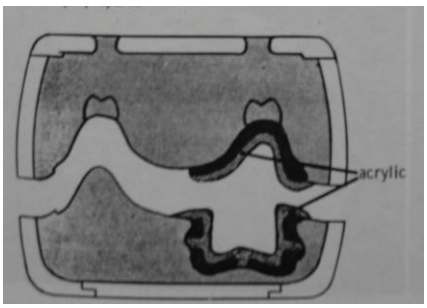
a] Case waxed and flasked



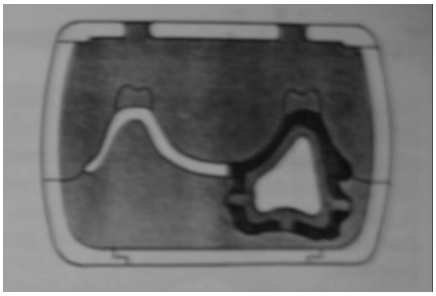
b] Wax boiled out

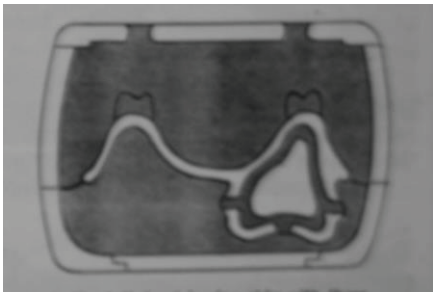


c] Stops prepared

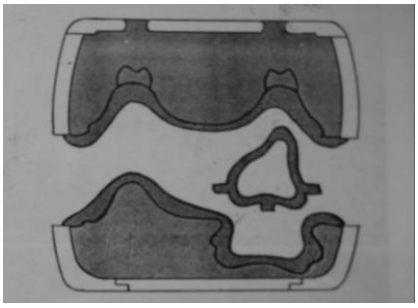


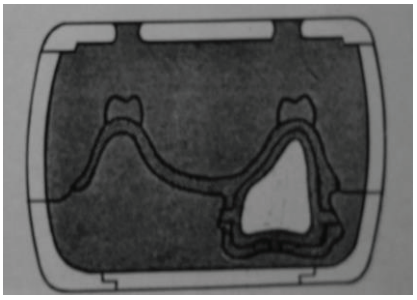
d] Acrylic added to defect &stops





e] Flask closed for shim polymerisation f] Wax boiled out leaving shim





g] Hard shim embedded into final packing h] Shim encased internally in obturator bulb

Modified flasking technique:

When wax pattern and cast are placed horizontally during investing for processing, the wall of buccal extension often exceeds the limits of internal dimensions of flask. With some modifications, the same flask can be used by placing the wax pattern and cast vertically. A continuous pressure injection (CPI) technique is used.

Advantages:

1. Not porous.
2. Free from flash
3. Easy to trim and polish
4. Reduces processing errors and increases resin density through layered polymerization of resin.93

Controversies between closed and open hollow obturators:

Closed obturator prevents collection of fluid and reduces air space in maxillary defect. However, fluids can be absorbed through porosity in the acrylic

resin seal between lid and obturator extension. Patient is unable to clean the hollow inner surface in a closed system. This non-hygienic condition creates a medium for growth of microbes.

Open obturator reduces the weight of the obturator, effect speech intelligibility and facilitate hygiene, easier to make. But it acts as a receptacle for nasal secretions and food, the patient might need to remove and clean more often, difficulty in polishing the internal surface. An alternative to both is an obturator with removable lid. Thin and small lid can be made up of vacuum formed thermoplastic resin sheets.[16]

Advantages of silicone obturator prostheses:

1.Flexible material permits partial collapse of obturator, which overcomes the problem of trismus

2.Allows entry through a palatal fenestration to a larger cavity above

3.Enhances potential for retention by use of more severe, divergent undercuts

4.May gain additional support from the cavity and so minimize both the leverage and force applied to the residual ridge.

5.It may also be remade independently of the associated denture.[94]

Hahn, Wood and Carl, Vergo and Chapman in 1980's proposed use of silicone obturator prosthesis to enhance retention and oronasal separation.[95] Obturator part was made of silcone material and the denture in acrylic resin. Adhesive was used to attach both parts.

In cases of complete avulsion of maxilla

A bony base to support the prosthesis is lacking whereas the lost residual ridges, palatal vault, PPS, buccal and labial sulci compromise retention. A further challenge is that jaw relation is disrupted; orientation of occlusal plane is lost.

Finally there are no anatomic landmarks to help determine the level of the palate and position of teeth.

Thin acrylic resin obturator record base was made first. Then at subsequent visits, an additional layer of functional impression material was placed on intaglio surface of record base, which effectively lowered the level of the palate. Patients' speech and swallowing were monitored with each addition aided by use of palatograms, until the contours and level of palate produced satisfactory speech and allowed patient to swallow comfortably.

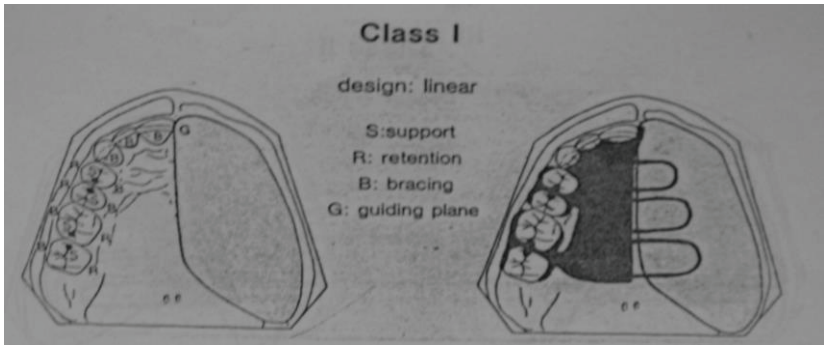
Teeth arrangement was based on phonetics and neutral zone concept. Anterior teeth were guided by lip position, nasolabial line angle, and tooth to lip relation. Posterior teeth were determined by neutral zone, muscular forces created during function of cheeks, tongue and lips.[40]

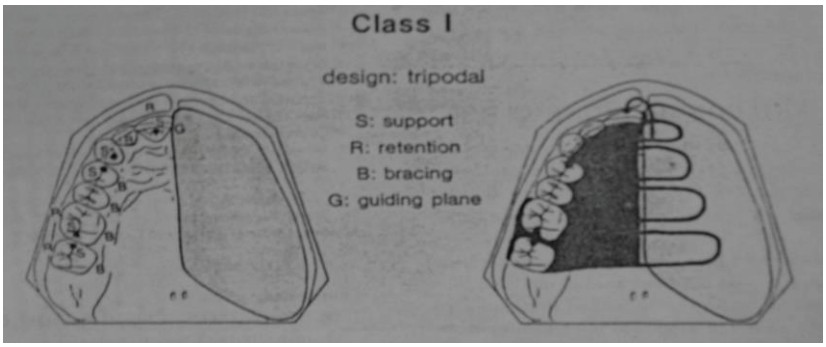
In case of microstomia, trismus, severe undercuts, design of sectional prosthesis is considered for both function and convenience of insertion and removal of large prostheses.

DENTULOUS PATIENTS AND MAXILLECTOMY DEFECTS:

Aramany gave classification and design principles in 1978.[10]

Class I: Resection is along midline.
Linear design: when there are no anterior teeth or they are not used and all posterior teeth are in straight line. Support is form posterior teeth and palatal tissue.
Tripodal design: when anterior teeth are used for support and retention

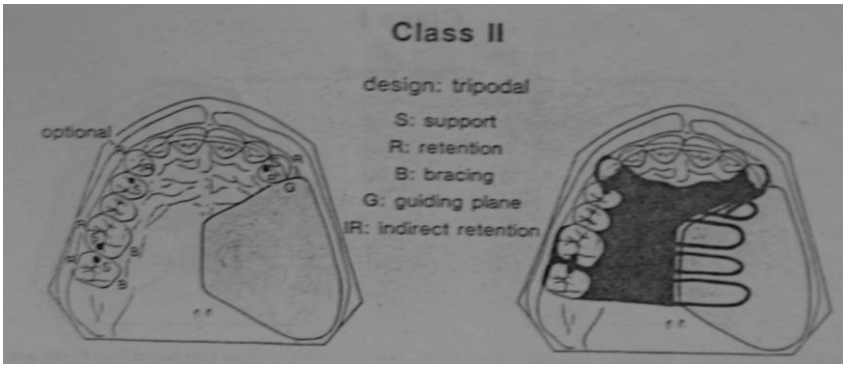




CIass II: unilateral defect, anterior teeth on contralateral side is retained. Similar to Kennedy's class II. Retention is placed buccally on all abutment teeth. Indirect retention is located on opposite side of defect

Support is from palate.

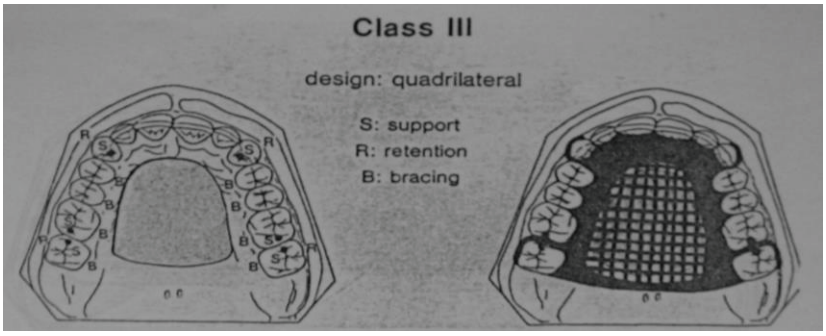
Tripodal design.



CIass III: defect is on central portion of palate and all the dentition is preserved. May involve soft palate. Similar to Kennedy's CIass III.

Bracing and support from widely spread abutment teeth.

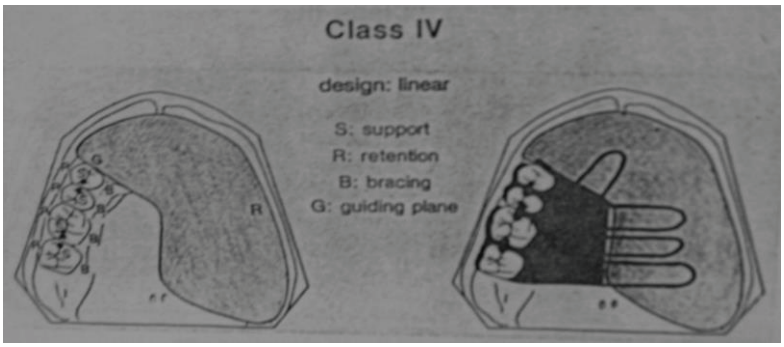
Quadrilateral design-simple and effective



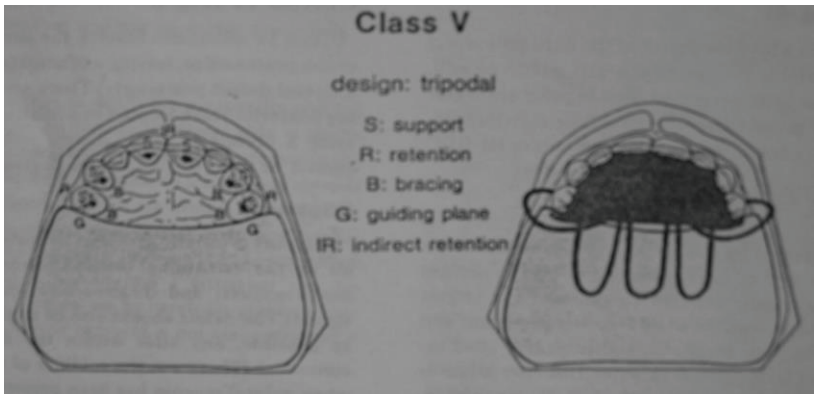
Class IV: involves surgical removal of premaxilla leaving a bilateral defect anteriorly and posteriorly.

Linear design.Support is located centrally on all remaining teeth.

Retention - mesially on premolars and palatally on molars.



CIass V: Bilateral posterior surgical defect located posterior to remaining teeth. Tripodal design, splinting of anterior teeth is suggested. I bar clasps are placed bilaterally on most distal teeth; support from all palatal surfaces.

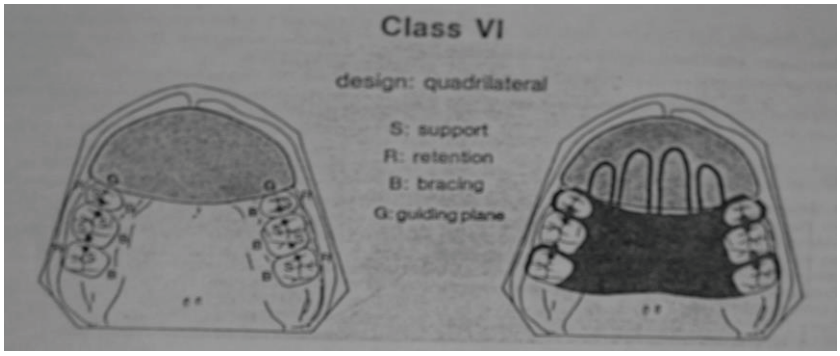


CIass VI: anterior palatal defect; rare condition

Results from congenital anomaly or trauma such as accident, self-inflicated wound leaving single bilateral defect located anterior to remaining teeth.

Support - from remaining teeth.

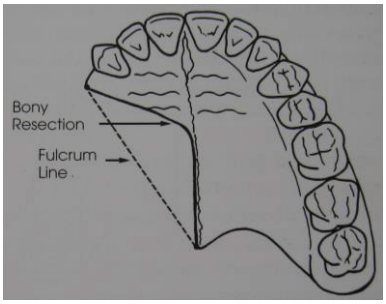
Quadrilateral design.



Surgical considerations:

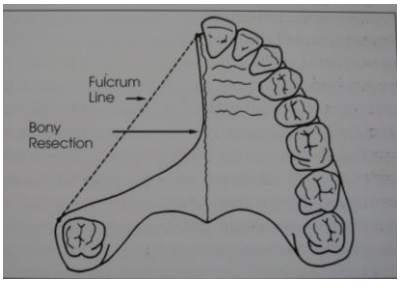
Efforts are made for converting class I defect into class II defect to provide a superior prosthesis both functionally and esthetically.

1.Preservation of contralateral anterior teeth, if it does not compromise tumour eradication.



2.If palatal mucosa is not invaded by tumor, it is preserved and reflected to cover the medial wall. This procedure gives superior tissue quality coverage for nasal septum.

3.Preservation of hard palate posteriorly on the defect side if tumor is situated anteriorly or laterally.



4.Resection through socket of tooth closet to specimen allows for maintenance of proximal alveolar bone adjacent to abutment tooth.

Surgical oburator:

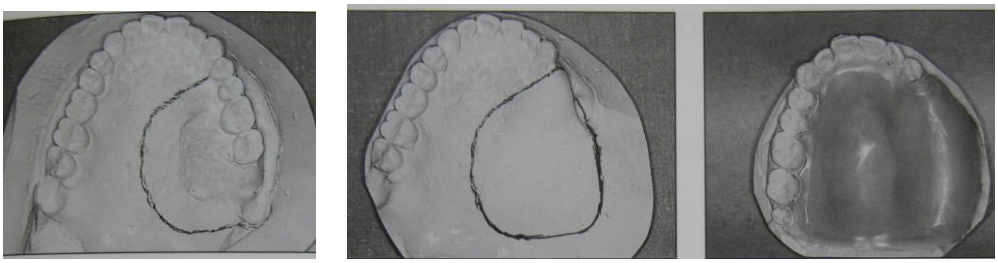
Two basic approaches:

One can fabricate the obturator according to most conservative line of resection, which allows it to be used for larger defects where surgical dressing may be needed to fill the defect between obturator and line of resection.

Advantage: can use the obtuator regardless of size of defect and does not require intra operative corrections.

Other option is to design and fabricate the obturator for most extreme surgical resection. Modifications may be needed with this type of design.

Pre operative impression is made. The teeth in the area of defect are removed and surrounding alveolar process in planned defect area is reduced by 2mm. Obturator is waxed and processed with heat \ self cure clear acrylic. If clasps are added they are to be placed such that they will not interfere with the occlusion.



Huryn suggested modifying the obturator with bur in operating room.[96]

Arcuri and Taylor – gave two approaches, one is conservative and the other is radical.[42]

Beumer et al recommended fabricating two or more prostheses pre surgically in order to be prepared for most eventualities.42

Mark Penn describes a technique:

Pre operative impression is made; outline of resection is done, make an index of teeth with PVS putty. Remove teeth in area of resection. Adjust artificial anterior teeth according to that in index. Remove the artificial teeth in question from wax before processing just making indentations on gingival aspect. Process the prosthesis. If the questionable teeth are resected add the teeth with self-cure to the indentations formed. If they are not resected slight adjustment of base is needed.

Advantage: easy, not time consuming, no need of prosthodontist to alter obturator in operating room, immediate esthetic improvement
Disadvantage: Additional steps.[42]

Definitive obturator:

Mouth preparation: maintain the remaining maxillary teeth and restore them to an optimum state of health. Definite endodontic and periodontic treatment should be completed. Splinting them to adjacent teeth may strengthen strategic teeth that are in less than ideal conditions.

Design considerations:

Moderate retention located at extreme points of remaining teeth, maximum support gained from occlusal and cingulm rests placed on all available teeth, and maximum resistance form or indirect retention from parallel guide plane surfaces on as many teeth as possible are recommended.

Cross section of RPD clasps located in opposing undercuts resist displacement along path of insertion and the clasps and bracing components resist dislodgement in all other directions.

Maxillectomy case: opposing clasps are not available and remaining components will tend to rotate around buccal clasp arm and fall away from tooth. This tendency occurs mostly in unilateral obturator cases.

Palatally placed retentive components are ineffective in gaining resistance to rotaional dislodgement.

Resistance to rotational dislodgment can be gained by placing parallel guide planes on the surfaces of abutment teeth directed toward defect side. They may act as IR, which resists dislodgement away from tissue.

When design of framework has been determined and mouth preparation performed, the final impression is made. The cast framework is tried in mouth to

verify complete seating and sufficient frictional fit to resist downward rotational dislodgment. If it is satisfactory impression of defect area is made; master cast is altered and obturation prosthesis is processed.
Post insertion instructions are given.

Assessing effective obturation:

Hahn considers that a silicone obturator enhances retention and seals the cavity tightly.

Vergo and Chapman state that obturation restores function to near normal.
Wood and Carl consider treatment to result in a functional and esthetic compromise

Laney and Gibilisco recommended use of border molding to ensure posterior seal and an extension over soft palate margin to create retention.

Desjardins says that obturator should make positive contact across the superior surface of soft palate and extend toward the pharynx for effective seal.

Watson uses lung function tests and radiography for assessing effective obturation. These methods offer simpler means to evaluate subjective experiences of the patient.[15]

Trouble shooting:

1.Leakage into the nose: This may occur several month or years after insertion of the prosthesis due to the continued fibrosis in the tissues bordering the prosthesis. The prosthesis should be disclosed with a tissue conditioning material and the patient performs functional movements. If swallowing and speech improves, then it should be evaluated for the area where the tissue conditioner is thickest. These areas should be relined.

2.Hypernasal speech: patients may complain of hypernasal speech at follow up visits. The prosthesis may be adequately closed at periphery, but the patient's soft palate and pharyngeal closure mechanism are not functional as fibrosis of soft

palate progresses. This condition is often seen when a portion of soft palate was resected. If there is adequate space to add a pharyngeal bulb to the posterior medial aspect of the prosthesis, this bulb can pass superiorly to the cut edge of soft palate and extend into the pharynx. In this way, the minimally functional soft palate is by passed by pharyngeal obturator.

CHAPTER 15: REHABILITATION OF SOFT PALATE DEFECTS

By Dr. Amar Kumar

Defects of soft palate are classified into:

Congenital- embryogenic development of hard and soft palate is interrupted, acquired-due to surgical resection of tumor etc.

Developmental - diminished capacity of soft palate to respond to functional demand.

Defects are also classified according to anatomy and physiology of the involved structures. These classifications identify the degree and type of palatopharyngeal closure. When some or all of the anatomic structure of the soft palate is absent, the term palatopharyngeal insufficiency applies. When the soft palate is of adequate dimensions but lacks movement because of disease or trauma affecting muscular and / or neurologic capacity, the term palatopharyngal incompetence applies. The term palatopharyngeal inadequacy includes incompetence and/ or insufficiency but may also suggest a reduction or absence of pharyngeal wall function.

Absence or loss of some or all of the soft palate results in insufficient structure or altered function of the remaining structure to provide closure with the pharynx. In this situation, an obturator prosthesis is designed to close the opening between the residual hard and / or soft palate and pharynx.

A partial soft palate defect may result from the surgical resection of the posterior border from the medial or lateral posterior portion of the soft palate. Such patients experience a range of defects, presenting with a portion of the soft palate remaining. Median posterior border defects occur after the resection from the uvula and posterior soft palate. In contrast lateral defects occur when the anterior tonsillar pillar and retromolar region are resected. With such defects, the velopharyngeal apparatus is compromised, and prosthetic obturation is the

treatment of choice. The complete soft palate defect is easier to trace and obturate compared with a soft palate that has been partially resected and is dysfunctional.[97]

Types of obturators

A **pharyngeal** obturator prosthesis, which may also be called **speech aid** or **speech bulb** prosthesis, extends beyond the residual soft palate to create separation between the oropharynx and nasopharynx. It provides a fixed structure against which the pharyngeal muscles can function to effect palatopharyngeal closure.

A **meatus** obturator is designed to close the posterior nasal choanae through a vertical extension form the distal aspect of the maxillary prosthesis. This obturator design may be indicated when the entire soft palate has been lost in an edentulous patient. Such a design will reduce leverage factors on the pharyngeal muscles against it. The meatus obturator is often thought to be mechanical, whereas the fixed horizontal pharyngeal obturator is thought to be more physiologic. The hinged pharyngeal obturator is not often indicated today because of the mechanics involved in its fabrication and apparent lack of advantage over the fixed horizontal obturator.

Palatopharyngeal inadequacy results in physical and psychosocial concerns for the patient. The objectives of prosthetic intervention are to prevent food and fluid leakage into the nose and to improve speech intelligibility. The prosthesis will include both pharayngeal and palatal or base sections. Pharyngeal extensions add bulk, weight, and leverage, thus generating stress to the supporting structure of the mouth through the palatal section of the prosthesis.

The design of the prosthesis must apply the basic principles of support, retention, and stability to minimize the stress generated to the structures of the mouth.

Jacob and King say that the soft palate obturator functions like the maxillary distal-extension removable partial denture because the obturator is

not retained distally and can be dislodged by gravity. Indirect retainers are usually incorporated in the design of a soft palate obturator. Improved anterior esthetics is gained with an obturator design that does not include retentive or stabilizing clasps on anterior teeth that have indirect retainer rests. Bilateral posterior circumferential direct retainers can successfully retain obturator in patients with acquired soft palate defects. With soft palate obturators, dislodging stresses are caused by the weight of the obturator and muscle action of the residual soft palate and pharyngeal wall against the obturator. As in the design of indirect retainers for distal extension partial dentures, the most anterior placement of the indirect retainer rest seat is recommended. Occlusal clearance, existing restorations, the need for new restorations, and esthetics can influence a more posterior placement of the indirect retainer without a clinically apparent loss in retention.[98]

Technical considerations of pharyngeal obturator prosthesis

The pharyngeal obturator prosthesis does not displace the soft palate but replaces missing portions of the soft palate. Therefore, pharyngeal obturator prosthesis has less active displacement force upon it than does a palatal lift. Despite the lack of active displacement forces, the obturator prosthesis continues to generate stress to the palatal portion of the prosthesis due to the forces of pharyngeal muscle activity and gravity.

The obturator section of the prosthesis is formed after the oral portion of the prosthesis is completed. A retentive loop is extended posteriorly from the palatal portion of the prosthesis to facilitate placement and retention of impression material in the pharynx. This extension should be parallel and close to the palatal plane. The acrylic resin extension must be of sufficient thickness at the junction of the obturator to the denture base so as to ensure adequate strength to prevent breakage. If a cast removable partial denture framework is used, the velar (soft palate) extension should be as strong as possible, ensuring enough strength to prevent fracture, particularly in the area where the tongue functions.[97]

Technique:

High-fusing modeling compound is added to the retentive loop posteriorly into the defect area taking care not to impinge upon the soft tissues. This first addition will serve as the tray. Additions of low-fusing compound are added until it contacts the posterior and lateral pharyngeal walls. Border molding is achieved by adding and removing modeling compound in the posterior and lateral pharyngeal areas. After the warmed modeling-compound addition is inserted, the patient is instructed to flex the neck fully to achieve contact of the chin to the chest. This movement will establish contact of the posterior aspect of the obturator with the soft tissue covering the anterior tubercle of the atlas. Rotation and flexion of neck form lateral aspects. The compound is rewarmed and patient is asked to swallow warm water to elicit pharyngeal muscle activity. When border molding is completed around the entire periphery, there should be no escape of liquid from the oral to the nasal cavities. Speech should sound normal, with the patient able to articulate plosive sounds such as b and p yet still be able to form the nasal consonants m, n, and ng. The borders should be checked for over or under extension, depending upon the remaining speech deficit.

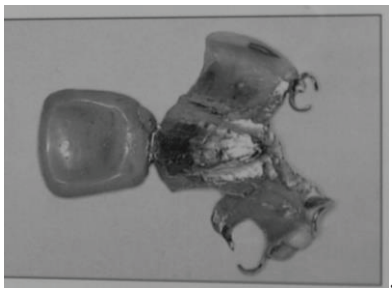
After slight but even (1 to 1.5mm) reduction of the compound on all peripheral surface of the obturator, a coating of mouth-temperature softening wax slightly thicker than the compound that had been removed is adapted to the modeling compound. The material is returned to the mouth and left in place for 8 to 10 minutes. The obturator may feel slightly tight to the patient, and sipping warm water will hasten the flow of the wax. Neck movements described above are repeated.

The inferior portion of the obturator is maintained parallel to the horizontal hard palate whenever possible. This level will prevent the tongue from dislodging the prosthesis during deglutition.

The obturator is carried to completion using conventional prosthodontic processing techniques. The inferior and superior surfaces of the obturator are highly polished while the tissue-containing areas are only lightly pumiced and then

buffed. At delivery, the obturator should be checked with a disclosing material to verify that no undue pressure is being placed on surrounding tissue.

Post insertion instructions: Care and cleaning of the prosthesis, cleaning of the tissues covered by the prosthesis should be explained and patient should be encouraged to remove the obturator for several hours each day.

 .

Hinged pharyngeal obturator

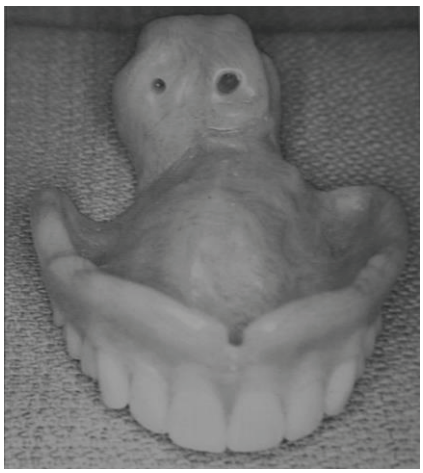
Technical considerations with the meatus obturator

The meatus obturator should be considered when the posterior extension of a fixed obturator prosthesis is likely to result in prosthesis displacement.[99]

The meatus obturator projects vertically at the posterior aspect of the prosthesis to obturate the posterior nasal choanae. Because the vertical extension is closer to the palatal portion of the prosthesis, there is less torque placed on the palatal portion, thus decreasing the tendency to dislodge. This prosthesis is most applicable to the fully edentulous patient who has undergone a total soft palate resection.[100]

> The oral portion or base of this prosthesis is fabricated to full extension in an effort to maximize retention, support, and stability. The vertical portion of the prosthesis is made in modeling compound supported by a wire loop extending vertically into the area of the posterior nares or choanae. The prosthesis is inserted with a rotational path, first seating the vertical extension to the posterior choanae and then seating the oral portion of the prosthesis. Incremental additions are made to register the anatomy of the posterior nasal openings in low-fusing compound. When the anatomy of both posterior nasal openings has been registered in compound, the patient should not be able to beneath through the nose with the obturator in place. When the vertical

extension has been formed satisfactorily in modeling compound, it is reduced 1 to 1.5mm and mouth-temperature wax is added to refine the adaptation to the posterior choanae and to reduce the risk of applying too much pressure on the sensitive nasal mucosa. Small holes are added to the meatus obturator to permit moderate nasal breathing. They must be at the best angle to prevent nasal regurgitation. Slope them downward towards the pharynx to allow drainage posteriorly by force of gravity.



Meatus obturator

Evaluation of effectiveness of treatment

Effectiveness of treatment with a palatal lift or pharyngeal obturator prosthesis may be evaluated through subjective or objective methods.

Speech evaluation will determine the presence of nasality. Following treatment, the palatopharyngeal contact is ineffective. If palatopharyngeal contact is excessive, the patient will experience hyponasal speech. Patient reports of food or fluid regurgitation may indicate inadequate palatopharyngeal closure.

Objective methods for evaluation of palatopharyngeal closure involve direct visualization, indirect visualization, and measurement of air pressure differentials. Direct visualization may be performed through the use a nasal endoscope. This fiberoptic scope is used to determine the presence or absence of oropharyngeal closure. Indirect methods of visualization involve the use of radiopaque fluids and cineradiogaraphy to assess fluid regurgitation. Air pressure in the oral and nasal cavities can be assessed to determine the presence of closure.

Neither approach is perfect. Experience of the clinician may be the most appropriate method to determine the best test for the patient in question.

CLINICAL APPLICATION OF PALATAL LIFT

The concept of a PLP was described by Gibbons and Bloomer, Beder et al, and Gonzalez and Aronson. The 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.[101]

Utilizing videofluoroscopy, nasal endoscopy, and airflow pressure measurements, the prosthodontist and speech pathologist can make a complete assessment of palatopharyngeal function. These diagnostic techniques help determine the need for, design of, and post insertion adjustments of the device.

Prosthodontists frequently provide palatal lift prostheses for patients with speech disorders due to palatopharyngeal incompetence, those with neurologic disorders affecting the oropharyngeal mechanism in whom the anatomy remains normal but, the musculature either no longer functions or functions at a reduced level of activity.

Etiology of palatopharyngeal incompetence may be due to a number of neurodegenerative disorders, including multiple sclerosis, amyotrophic lateral sclerosis (ALS), tumors of the cranial region, or traumatic head injury.

Palatopharyngeal (or velopharyngeal) incompetence, defined as having normal anatomy but ineffective or absent motor function, is distinguished form palatopharyngeal insufficeincy. Palatopharyngeal insufficiency is caused by abnormal anatomy. Patients with cleft palate or those who have suffered resection of the soft palate or lateral pharyngeal wall suffer from palatopharyngeal insufficiency. As a general rule, palatopharyngeal insufficency is treated with a pharyngeal prosthesis or speech bulb prosthesis. Palatopharyngeal incompetence is

treated with a palatal lift. The purpose of palatal lift prosthesis is to obtain velopharyngeal closure by displacing the soft palate to the level of normal palatal closure at the palatal plane. Once the soft palate is elevated, the pharyngeal walls ideally can complete closure of the nasopharyngeal port. For a palatal lift to work effectively there must be some residual movement of the pharyngeal walls. The goal is to obtain a reduction in the size of the palatopharyngeal opening with a subsequent decrease in nasality. This in turn will allow increased oral air pressure necessary for intelligible articulation.

Palatopharyngeal functions

The muscles of the soft palate and pharyngeal walls work in concert to effect palatopharyngeal closure. The levator veli palatini and the superior constrictor are the primary muscles performing the majority of the work of closure. When the levator palatini (paired muscles joined in aponeurosis at the midline of the soft palate) contract, the soft palate moves superiorly and posteriorly until it contacts the posterior pharyngeal wall. This contact occurs at or slightly above the level of the palatal plane. The level of posterior wall contact also corresponds with the level of the anterior tubercle of the atlas, a convenient radiographic landmark. This posterior pharyngeal wall function is referred to as the Passavant pad or ridge. This small ridge of muscle contraction tends to lag slightly behind the rest of the sphincteric closure mechanism and fatigues rapidly on repeated contraction.

Simultaneous with soft palate elevation, the paired superior constrictors in the lateral pharyngeal walls move medially to contact and press into the lateral portion of the elevated soft palate. Normal speech requires full closure of the nasopharyngeal sphincter and tight palatopharyneal closure is necessary for swallowing.

Palatopharyngeal incompetence is characterized by hypernasality and a decrease in intraoral air pressure during the production of oral speech sounds, causing decreased intelligibility.

Indications and prosthodontic determinants for lift fabrication

Indication for fabrication of a palatal lift is the diagnosis of palatopharyngeal incompetence.

A primary requirement for a successful palatal lift is retention. Because the palatal lift is a posterior extension cantilevered from a removable denture base, the ability to keep the base portion in the correct position is critical to success of the lift. Teeth (or implants) that can serve as abutments for the lift are requisite, although occasionally a lift can be successful with a complete denture as the base. Abutment teeth should be strategically located to give the maximum mechanical advantage. Posterior teeth like second or even third molars are the best abutments for palatal lift construction because they are closest to the cantilevered lift extension. The absence of posterior teeth, while not a strict contraindication to lift construction, will likely decrease the prosthodontist's ability to fabricate a retentive palatal lift that will resist dislodgment. Retentive undercuts on the abutment teeth are necessary and can be created with the addition of composite resin or orthodontic brackets if natural tooth contours are insufficient.

Determine the potential amount of force that will be required to lift the soft palate to create the desired effect prior to committing to lift fabrication. The soft palate is easily displaced upward by pressing on it with a mouth mirror or tongue blade. If the soft palate resists displacement because of fibrosis or tonicity of the muscles, a palatal lift may not be successful. Too much force will be required to lift the palate and will likely result in a lift that cannot be kept in place or in pressure irritation and ulceration of the mucosa of the soft palate.

Another diagnostic consideration is the amount of residual pharyngeal wall function. A palatal lift functions best when there is residual function of the superior constrictor muscles and is especially effective if the levator muscles still have some ability to contract.

Fabrication

Fabricate the palatal lift as a provisional device with an acrylic resin base portion to determine the success of treatment before committing to a cast removable partial denture framework. It can be modified by casting a metal extension or incorporating a heavy gauge wire to reinforce the denture base with the obturator bulb extension. This is particularly advisable for a young patient whose needs are expected to change frequently. If a cast metal framework is preferred, fabrication of the oral portion of the lift is identical to the fabrication of a removable partial denture framework, including design and mouth preparation.

Accurate impressions of both arches are made. Capture as much of the posterior palate as possible. Extension of at least 2 cm posterior to the fovea palatine is desirable. The tray in this area must support the impression material so that the soft palate is displaced. This will allow placement of the wire loop in the proper position to support the lift portion of the device. For a patient with an exceptionally long arch form, a custom tray may be required to facilitate registration of the soft palate.

Surveying the resultant cast will determine the presence or absence of adequate retentive areas on the abutment teeth. The ideal position for the retentive clasps to engage is in a distobuccal undercut on the most posterior tooth on either side of the arch. This will place the retentive elements as close to the cantilever of the lift portion as possible. Utilize indirect retention as far anteriorly as possible to make the retentive clasps effective. The mesial marginal ridge/fossa of the first premolar is usually a good position for the indirect retainer as it is far enough anterior to the fulcrum line to provide a favorable leverage.

The retentive loop for the lift portion of the device should extend posteriorly from the base portion approximately 2 cm. This length will provide adequate support for the lift molding process but will not extend so far as to interfere with processing. The loop should be on the same plane as the hard palate but should have slight relief between itself and the cast to allow for impression material and ultimately acrylic resin to coat the

superior surface. The width of the lift in the area immediately posterior to the oral portion (the isthmus) does not need to be excessively wide, as this portion does not function but is rather a connection between the base portion and the lift. It should however, be sufficiently wide and thick to support the lift under heavy pressure without fracturing.

The loop should be in contact with and slightly displacing the soft palate. Generating the lift portion is different from generating a pharyngeal obturator prosthesis in that border molding to register the functional movements of the surrounding musculature is not done. Modeling compound is applied to the loop, shaped, flamed to create a smooth surface, and then chilled before placing it into the mouth. If softened compound is placed in the mouth, the soft palate will displace it downward and the lift action will not occur. Displacement of the soft palate is the goal of the procedure and can only be accomplished with hardened compound.

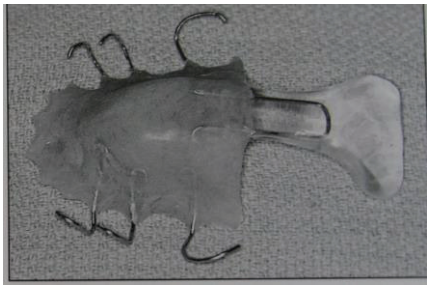
The first addition of compound should cover the loop evenly and extend several millimeters beyond. The chilled compound is carried to the mouth and seated. The patient is allowed to wear the palatal lift for several minutes at this stage to begin to become familiar with the sensation of the lift. Small additions are made to the compound posteriorly until the soft palate is brought into light contact with the posterior pharyngeal wall. At this stage, space will remain between the soft palate and lateral pharyngeal walls.

Avoid adding excess compound to the lift on its oral surface. If the posterior tongue contacts the underside of the lift, the patient will experience sever gagging.

Enlargement of the lift ceases when the speech professional is satisfied with the result, when the patient can no longer breath through the nose, or when the downward force of the soft palate dislodges the lift and the retentive limit of the clasps has been passed. If the patients can no longer breathe through the nose, compound is removed from the lateral aspects of the lift until breathing is restored.

The final step in lift generation is to reduce the entire surface of the compound by 1 to 2 mm. Mouth-temperature softening wax is applied in sufficient amount to replace lost compound, and the lift is tempered and reinserted. The patient is asked to speak, swallow water, and move the head in all directions to form the wax. The lift is removed after approximately 5 minutes and evaluated carefully for thin areas that might indicate excessive pressure on soft tissue. If thin areas are found, the underlying compound is scraped to reduce it further, wax is reapplied, and the lift is placed back in the mouth for an additional 5 minutes.

Following the lift generation session, the lift portion of the device is replicated in acrylic resin. It is carefully finished and polished to ensure that there are no residual rough or sharp edges that might lacerate the distended soft palate mucosa.



Palatal lift prosthesis

Insertion and patient instructions

During the insertion appointment, the effectiveness of the lift is again confirmed. Nasal endoscopy is the method of choice to evaluate the effect of palatal lift therapy, but other tests are also effective in varying degrees.

Care should be taken in arbitrarily reducing the size of the lift at this stage, as a properly functioning lift will demonstrate significant pressure on the soft palate and the disclosing medium will reflect moderate pressure. Only those areas of obviously heavy pressure should be reduced and repolished.

The patient should be seen within 2 or 3 days of delivery of the palatal lift. Patients with residual nasal airway with the lift in place may accommodate its presence and be quite comfortable with the lift. Others may use it only sparingly when speech with people not accustomed to hearing the patient speak with hyper nasality is required.

The value of eating with the lift in place is also something the patient will have to determine. Some will find it more comfortable to eat without the lift.

The patient should not wear the lift while sleeping, to allow the mucosa of the palate to recover from the coverage and pressure caused by the lift. Supraeruption of the clasped abutment teeth could conceivably be a concern, particularly when substantial pressure is required to keep the soft palate elevated. Removal of the lift at night would reduce the amount of time that the abutment teeth are under eruptive orthodontic forces.

Sato says that 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.[101]

Technique:

Make preliminary impressions and pour casts. Alter the soft palate of the diagnostic cast to simulate the contour of raised soft palate. Make final impression with custom tray. Following jaw relationship records and arrangement of artificial teeth, wax the palatogram section. Leave two openings to reduce weight. Process the palatomaxillary section separately and palatopharyngeal section separately. On the master cast, embed Ni-Ti wires in both the sections with self-cure resin to relate the sections to each other.

Clinical evaluation

Speech

Intraoral pressure. When measuring the intraoral pressure of a patient with restricted soft palate movement in pronouncing/pa/, the air predominantly passes through the nose. On insertion of the PLP expired air passes through both the nose and the mouth.

Single sound. Insertion of the PLP permits clear pronunciation of /p/ and /t/ and some improvement in pronunciation of /k/, /b/, and /d/.

Cineradiographs. The soft palate showed moderate mobility after insertion of the prosthesis.

Contextural speech. After insertion contextural speech was generally acceptable.

Swallowing

The PLP with Ni-Ti wires connecting the palatal and pharyngeal section subjectively prevented the regurgitation of food and liquid during swallowing.

From the physiologic standpoint, it may be desirable that the palatopharyngeal section is movable to better simulate soft palate movement during speech and swallowing.

The flexibility of Ni-Ti wire seems to be more effective than other materials. To satisfy the need for both the retention of PLPs in edentulous patients and the force needed to elevate the soft palate, the elasticity of the wires should be carefully selected for each patient.

This method may be useful for some edentulous patients with hypernasal speech.

Outcome evaluation

LaVelle and Hardy (1979) defined three satisfactory outcomes for palatal lift prosthesis.

An **optimal** result occurs when the prosthesis results in palatopharyngeal port closure during speech production of nasal consonants; that is, the resulting pattern of closure would be essentially normal.

The result is considered **successfu**l when there is palatopharyngeal closure throughout speech production. These patients generally end up hyponasal with their prosthesis in place. This is because they are fully closed and are not able to get airflow when saying their nasal sounds such as m n and ug.

The result is considered only **desirable** when the palatopharyngeal port area is reduced so that incompetency is a relatively minor speech physiology.[10]

CHAPTER 16: REHABILITATION OF MANDIBULAR DEFECTS

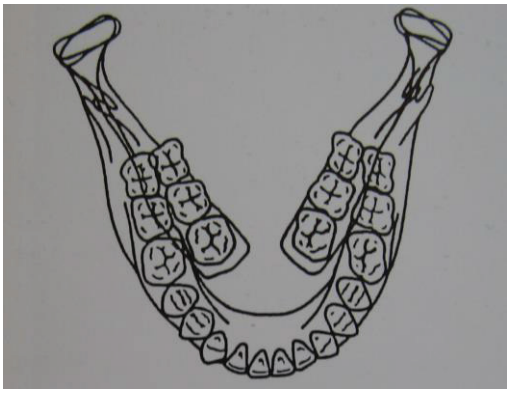
DIAGNOSTIC CONSIDERATIONS IN MANDIBULECTOMY PATIENTS

By Dr. Abhishek Gupta

Location and extent of mandibular defect

The resection of a portion of mandible without loss of mandibular continuity is usually not difficult to restore.

Resection of anterior mandible is the most debilitating type since it compromises esthetics and function due to loss of genioglossus and geniohyoid muscles.



Prosthodontic rehabilation is to be done after surgical reconstruction and segment stabilisation. Surgical reconstruction of the mandibular body/ramus is of benefit in creating a stable foundation for prosthodontic rehabilitation with endosseous implants or conventional prostheses.

Presence of remaining natural teeth or pre-existing implants

The patient needing rehabilitation following mandibulectomy frequently presents with few or no remaining natural teeth.

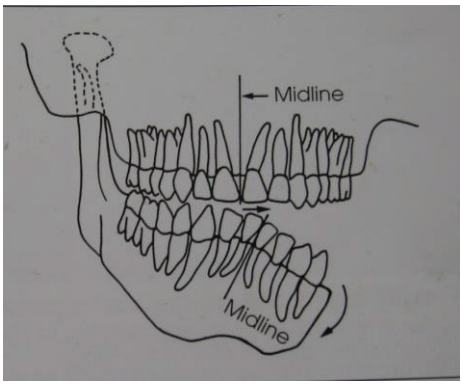
The presence of remaining teeth or implants in the mandibular arch following resection may be the most important factor used to determine the prognosis of rehabilitative therapy. When even one or two teeth remain in

the mandible the patient is much more likely to tolerate a removable, tissue-supported prosthesis. Teeth present on both sides of the midline permit greater prosthesis support because the problem of straight-line design can be avoided.

The presence of remaining natural teeth in the opposing maxilla is not nearly as important as the number and location of remaining mandibular teeth for predicting post rehabilitation success for the mandibulectomy patient. A complete maxillary denture will usually function quite well against a reconstructed mandibular dentition; exceptions include difficulty in fabrication of a maxillary complete denture where the residual proximal mandibular stump, including the coronoid process, has collapsed against the posterior maxillary alveolus prohibiting adequate denture flange extension necessary for peripheral seal. A complete maxillary denture will also be a problem when a mandibular guide flange prosthesis is planned to correct mandibular deviation. Pressure from the guide flange will tend to dislodge the maxillary denture.

Degree of post mandibulectomy rotation and deviation

Loss of mandibular continuity causes deviation of the remaining mandibular segments toward the defect and rotation of the mandibular occlusal plane inferiorly. Mandibular deviation toward the defect side occurs primarily because of the loss of tissue involved in the surgical resection.



Loss of continuity also results in vertical rotation of the residual mandibular segment in an inferior direction. Rotation is caused by two factors. The pull of the suprahyoid musculature on the residual mandibular

fragment causes inferior displacement and rotation around the fulcrum of the remaining condyle. The second compounding factor causing mandibular rotation is gravity. The loss of anchorage of the elevator muscles and temporomandibular ligament on the defect side allows the mandible to fall vertically away from its normal position. The functional results of deviation and rotation of the mandible are facial disfigurement, loss of occlusal contact between remaining maxillary and mandibular teeth, and, in many cases, loss of the ability to bring the lips together for saliva control and to initiate the swallowing process.

Treatment for mandibular deviation and rotation is best done by restoration of continuity through osseous grafting. When restoration of mandibular continuity is not possible, early postresection physical therapy is indicated to reposition the mandibular fragment toward a more normal position and to minimize the effect of scar formation that will make deviation more severe and less amenable to prosthodontic intervention. The physical therapy should involve having the patient gently push the mandible away from the defect toward a more normal position. While holding the mandible in position, the patient should open the mouth as widely as possible to stretch the musculature and the resection site. Repeated opening and closing while maintaining the mandible in its normal alignment is useful to train the mandible and to prevent or limit the effect of scar formation in the resection site. Stretching exercises are extremely important during the early rehabilitative phase, if physical therapy and reposition training are delayed until after the initial postoperative healing phase of 6 to 8 weeks, it is unlikely that exercise and physical therapy will be beneficial. Reposition training of the resected mandible becomes much less effective as time following surgery increases.

If minimal pressure is required to maintain the mandible in its correct position, a mandibular guide flange and / or a maxillary guidance ramp may be a partial solution to the problem of deviation.

Mandibular guidance prosthesis is not likely to be successful and may be damaging to the remaining teeth and soft tissues if maintaining the mandible in its correct position requires the application of force beyond that needed to gently assist correct repositioning. If even moderate force is required to maintain mandibular position, the clinician should consider utilizing a maxillary casting that provides a buccal bar for the mandibular guidance prosthesis to slide against. This serves to splint and protect the surfaces of the maxillary teeth against which the guidance prosthesis functions.

Neither mandibular guidance prostheses nor palatal guidance ramps are indicated for edentulous patients without the use of implants.

Available mouth opening

There is limited mouth opening, which becomes severe as healing progresses during normal healing. Postsurgical trismus can be treated by stretching exercises like placing a finger on the mandibular arch and pulling downwards, giving stock or custom made appliances, moist heat and analgesics. Exercises must be initiated within 2 weeks, preferably at 1week, following surgery.

Fibrosis creating mature scar tissue is much more difficult to treat and to improve on with stretching exercises. Stretching exercises have generally been of limited benefit for patients with long- standing limitation of opening.

Treat limitation of opening aggressively at an early stage to prevent permanent, severe scarification.

Functional limitation of tongue

Degree of impairment of tongue function is more important factor in determining the prognosis than the presence or absence of teeth to serve as abutments.

The surgical wound is closed by suturing the remaining tissues of the floor of the mouth or the tongue to the remaining buccal tissues. This method of wound closure severely limits the mobility of the tongue depending upon the size and location of the defect. Limitation of normal tongue mobility will seriously compromise speech, swallowing, mastication and control of a food bolus, and ability to control a removable prosthesis. Severely limited tongue mobility as a prognostic factor for rehabilitative success frequently dictates surgical revision of the mouth floor to restore tongue mobility.

Lack of tongue mobility is due to tethering or the result of resection of a significant portion of the tongue itself. Tethering can be addressed by surgical release of the tongue; loss of substantial tongue volume is less likely to be improved significantly by vestibuloplasty.

Loss of sensory innervations will severely compromise tongue function and the prognosis of prosthodontic rehabilitation. When the lingual nerve (trigeminal / fifth cranial nerve) is sacrificed during resection, the tongue on the defect side will permanently remain without feeling. Loss of sensory capability will preclude effective speech, mastication, and prosthesis placed on the side of the defect.
Any prosthesis placed on the defect side will serve only for cosmetic replacement of missing teeth and contiguous structures, to support normal facial contour, and, possibly, to prevent supraeruption of opposing natural teeth or to assist in stabilizing an opposing complete denture.

The patient must understand that mastication on the side with tongue anesthesia is very unlikely. Loss of sensory innervation of the buccal mucosa (long buccal nerve) and the lower lip (mental nerve) will reduce the patient's ability to control food and saliva.

Loss of motor innervation of the tongue is encountered less frequently than sensory innervation because the hypoglossal (12^{th} cranial)

nerve lies deep in the floor of the mouth at the base of the tongue and is less frequently involved in floor-of-mouth/ mandibulectomy resection.

Anterior mandibular resection in the symphyseal region is more debilitating than posterior mandibular resection, but posterior resection of the tongue is much more debilitating than anterior resection.

Compromise of vestibular extensions

Loss of the vestibule following surgical resection may dramatically affect the prognosis of tissue- supported removable prosthesis because of the loss of normal border extensions.

Surgical recreation of vestibular depth both buccally and lingually should be considered in many of these situations.

Skin grafting

Skin as an oral graft material has several distinct advantages and disadvantages that must be considered.

Transplanted tissue does not have sensory innervation and can be susceptible to trauma from ill fitting or over loaded prostheses.

Dental implants used in sites with grafted skin may also create problems. Skin in oral environment, does not tolerate the titanium surface of implant abutments, and the reaction might be severe. Mitchell in 1990 recommended custom fabricated gold components to solve chronic irritation when titanium penetrates skin.

Radiation therapy

Tissues that have been radiated are fragile, sensitive to manipulation, desiccated, slow to heal, prone to infection and are at risk for osteoradionecrosis.

Previous experience with removable prostheses

A patient's prior experience with removable prostheses may be an indicator of how successful rehabilitation will be.

Altered anatomic relationships following restoration of mandibular continuity:

Wang states that after a Mandibulectomy, the mandibular fragments are prone to displacement by contraction of the muscles of mastication, scar contraction, and misalignment during surgical approximation and / or fixation. The anterior mandibular region is difficult to reconstruct because of the curvature of the mandible.

Restoration of mandibular continuity is of primary importance in determining the prognosis of postmandibulectomy rehabilitation. Grafting the anterior mandible frequently results in a graft that is deficient anteriorly. The prosthodontic difficulties seen in rehabilitating a patient with this type of defect are numerous. They include:

1. An inability to provide adequate lower lip support for esthetics
2. Speech problems associated with mandibular dentition placed too far lingually to allow normal articulation
3. Inability to control a food bolus due to lack of motor function of the lip and muscles of the lower face
4. Excessive display of mandibular teeth due to the patient's inability to maintain normal lower lip posture
5. Difficulty gaining adequate space for prosthesis placement without encroaching on the function of the tongue
6. Misalignment of the remaining unresected mandibular fragments and resultant relationships between mandibular and maxillary teeth. Such misalignment is variable in relation to the maxilla and the degree of difficulty encountered during prosthodontic rehabilitation.

Reconstruction of posterior defects with bone grafts is somewhat more predictable from the standpoint of prosthodontic rehabilitation than anterior defect but problems associated with size and positioning of the bone graft may still cause difficulties. The mediolateral position of the graft is frequently seen to be lateral to the original position of the mandibular body. This results in a prosthesis built in crossbite to maintain the denture teeth over the supporting base of the bone graft. When implants are utilized, the implants require extremely angled placement, and the prosthesis they support may have to be cantilevered further to the lingual to permit tooth contact.

The surgically reconstructed mandible frequently presents a situation in which the interarch space between the bone graft and the opposing maxilla is either greatly diminished or greatly exaggerated.

REHABILITATION OF MANDIBULECTOMY PATIENTS

The mandible is a single bone that creates the peripheral boundaries of the floor of the oral cavity. Muscles of mastication are bilaterally attached to the mandible to generate a variety of complex mandibular movements useful in speech, swallowing, mastication, and respiration. The mandible and the muscles of mastication also give form to the lower third of the face.

Resections of the mandible may cause topographic defects while maintaining continuity, but facial form and movements of the mandible can often preserved. Discontinuity defects of the main body of the mandible cause deficits in facial form. They also affect mandiular movement consistent with loss of muscle attachments and unilateral preservation of contralateral muscle attachments.

Schneider and Taylor gave review on mandibular resection guidance prostheses: [103]

Ackerman advocated the use of intermaxillary fixation or guidance prosthesis immediately postoperatively. The prosthesis design used a “gate-hinge clasp’’for maximum stability during function. This design is quite similar to current “ swing-lock’’ removable partial dentures. Ackerman felt that intermaxillary fixation decreased the mandibular deviation.

Adisman fabricated guide plane splints that were used as preoperative intermaxillary prostheses. After healing, the fixed prosthesis was replaced by a mandibular removable partial denture guide plane with a wire loop extension into maxillary mucobuccal fold. The extension functioned against the maxillary posterior teeth and helped diminish the degree of mandibular deviation. He stated that if condylectomy was done a resection guide plane prosthesis was necessary.

Robinson and Rubright stressed the use of preoperative mounted casts on which a temporary acrylic resin mandibular guide flange prosthesis could be fabricated. He inserted this on the third postoperative day, and used by the patient for one year. At the end of one year the patient was able to move the mandible into a functional relationship without assistance.

Sannell stated that after mandibular resection the dentist should see patient as soon as possible i.e. within 7 days. Corrective guide flange prosthesis inserted early can avoid difficulty in mandibular movement and function. He also observed that a delay of weeks or months before dental therapy was instituted could cause displacement that is impossible to correct.

Riley advocated a change in the surgical procedure and a variation in the prosthesis to reduce mandibular deviation. He believed that a cut across the ramus in a perfect half circle would prevent mandibular deviation. For patients experiencing total mandibular resection and reconstruction a tube-sleeve connector was used to connect a mandibular denture to a cast maxillary removable partial denture to facilitate mandibular guidance.

Kelley stated that with the loss of anterior teeth and with healthy teeth in one or both posterior regions of the mandible, rigid retainers with trombone-arm or

double arm stress breakers could be used as mandibular removable partial denture major connectors. He believed that this design prevented lateral movement but allowed vertical movement of the mandible.

When treating edentulous mandibular resection patients, Swoope formed a palatal ramp on the maxillary denture to broaden the occlusal table made make it easier for the patient to obtain stabilizing occlusal contacts. The ramp was initially formed in wax as the patient attempted to move the mandible as far as possible toward the non-defect side. The patient supplied the force while the dentist guided the mandible.

Brown stated that endentulous patients who have experienced mandibular resection with no recurrence for a year are candidates for prosthetic treatment. No mention was made of the treatment of the mandibular deviation that may be present in the year after surgery.

Schaaf described removable partial denture flange prosthesis for the patient with remaining natural teeth. In partially edentulous patients if the teeth are strong enough, a mandibular cast removable partial denture flange prosthesis can be used to reduce mandibular deviation. With partially edentulous patients with weak teeth, or if deviation has been present for a long time, the dentist should record an occlusal relationship that allows freedom of lateral mandibular motion and a Monson curve type of occlusion may be indicated as a guide**.**

Aramany and Myers presented a philosophy of treatment that advocated intermaxillaaary fixation for 5 to 7 weeks immediately after surgery. For the dentulous patient, if mandibular deviation is noted after the patient attains the intercuspal position, the guide flange can be used for period of a few months if the deviation recurs. They noted much less mandibular deviation with patients who had had undergone intermaxillary fixation for the 5 to 7 weeks than with those who did not.

In 1977, Desjardins and Laney stated that using intermaxillary fixation at the time of surgery minimizes mandibular deviations. Patients with; small surgical

defects could train themselves to occlude their teeth by the use of hand pressure on the defect side. For patients who are able to achieve occlusal contact but cannot repeat the position for mastication, guide flange prosthesis is indicated. The retraining prosthesis is used for a period of time that varies with the patient and the extent of the defect. In addition, a palatal ramp and wide occlusal table may be used for dentulous patients if acceptable occlusal contacts of the natural teeth cannot be attained.

Mc Casland suggested that patients use straight opening and closing exercises to train the neuromuscular system to avoid deviation of the mandible. He also stated that if the anterior belly of the digastric on the ipsilateral side is resected at the time of neck dissection, less mandibular deviation is observed.

In 1979, Desjardins stated that many mandibular resection patients need a guide prosthesis to assist in muscle retraining for mandibular movement. In dentulous patients, a maxillary palatal inclined plane, palatal to the posterior teeth on the nondefect side was mentioned as a possible training device. Inclined planes are not used in edentulous patients because denture stability may be compromised. Therefore, retraining of mandibular deviation in the edentulous patient may not be possible. For dentulous patients who can achieve proper occlusal relationships but cannot hold that position for adequate mastication, a lateral guide flange may be used. The prosthesis is designed to maintain a vertical chewing stroke with little or no lateral movement.

Chalian et al indicated that a guide plane prosthesis must be used if the resection includes the body of the mandible, ramus, and condyle. These prostheses consist of a maxillary and a mandibular cast removable partial denture framework. The frameworks are designed to be in contact during function and to limit mandibular deviations. A lower inverted U- shaped flange slides against an upper horizontal bar on the nondefect side. Masticaton is limited to vertical movement. Additional care may include reshaping the occlusal surfaces of the artificial posterior teeth to provide broader occlusal surfaces, atypical contouring of the denture base to add to the facial contour, and continued reassurance for the patient.

Beumer et al suggested a number of treatment modalities to treat mandibular deviation, which include intermaxillary fixation, palatally oriented guidance and mandibular-based guidance prosthesis. For optimum results, these prostheses should be combined with an organized exercise program. The exercise program can be started 2 weeks postsurgically and consists of the patient grasping the chin and moving the mandible away from the surgical side. They give no specific direction as to duration of the program or other physiotherapy that could be performed.

Cantor and Curtis found that the residual mandible could be guided to a centric occlusion position when mandibular teeth are retained. If the patient is edentulous, exercises are advocated instead of mechanical guidance because the denture can be easily displaced.

Dentulous patients are easier to retrain to achieve a more normal mandibular movement, to facilitate mastication, and to improve facial appearance. Palatal guidance ramps or mandibular guide flange prostheses have been used with equal success.

Edentulous patients are much more difficult to retrain in mandibular movement, and many may never achieve proper maxillomandibular relationships for optimum mastication and appearance. The dentures designed with a palatal guide ramp or widened occlusal table to compensate for the deviation are easily dislodged due to the decreased muscle control and loss of stress-bearing areas. If the patient has undergone radiation therapy, the tissues may be friable, and the patient may experience xerostomia.

The head and neck cancer patient requires a tremendous amount of time and effort for an effective evaluation, treatment plan, and treatment. A team approach is emphasized in prosthodontic rehabilitation and includes a physical therapist knowledgeable in the special needs of the cancer patient.

Mandibular Resections: Surgical Considerations

Marginal Mandibulectomies

Marginal mandibulectomies involve resections of the mandibular body with overlying soft tissues while maintaining the inferior cortex of the mandible and its continuity. The muscles of mastication are usually intact, so mandibular movement is not disrupted. Soft tissues are used to reconstruct marginal mandibulectomies.

Discontinuity mandibulectomies

Discontinuity mandibular resections require resection through the entire mandible and may involve any part of the mandible from condyle to condyle.

Mandibular deviation: unilateral resection

If there is a unilateral resection of the ramus that extends to the angle of the mandible, the pterygoid and temporalis muscles attachments are lost unilaterally. Deviation is likely to be observed but will probably be minimal due to bilateral maintenance of the masseter muscles. Such a patient may be able to return to appropriate intercuspation.

If the ramus is maintained as a separate bony segment, proximal to the bone resection, the ramus will become malpositioned due to its temporalis muscle and lateral pterygoid attachments. It is pulled superiorly by temporalis muscle and medially against the maxilla by the pterygoid muscle. This position obliterates the maxillary buccal vestibule and hinders making a maxillary prosthesis and performing hygiene on the maxillary posterior dentition. In the past, bony reconstruction was not routinely contemplated and the ipsilateral ramus was resected to prevent this positional problem. When delayed reconstructions are planned, internal fixation plates or external fixation devices should be used to span the bony their preoperative position.

Rotation of the mandible occurs with unilateral resection. This rotation is observed anteriorly as inferior rotation with anterior disclusion and posteriorly as a movement of the mandibular posterior contact form the buccal cusp tips to the buccal inclines of the buccal cusps.

When the resection is in the body of the mandible and creates two large independent segments of mandible, the two segments will act independently of each other, influenced by their remaining muscle attachments.

If the resection splits the mandible near the midline, the two segments collapse toward the middle of the mouth. Both segments deviate medially and rotate inferiorly. No coordinated movements occur and the patient cannot concentrate on either side of the mandible to effect a repeatable occlusion. The mandibular segments are constantly changing position during the opening and closing of the mandible. Due to this constant change in position, an intraoral prosthesis cannot be fabricated to unite the two segments. These midline resection patients require bony reconstruction.

Mandibular malposition after bony reconstruction

Despite bony reconstruction, the ideal arch form is frequently not obtained.

Patients may present with residual deviation and rotation to the surgical side after bony reconstruction. This can occur in an immediate reconstruction for two reasons. First, there is minimal proximal mandible on the surgery side to attach the bone graft, and / or second, the mandibular segments are not stabilized and maintained in their preoperative relation to each other during the grafting procedure.

The easiest way to maintain the segments is to bend a metal reconstruction plate intraoperatively to follow the contours of the mandible and to span the resected mandibular section. This plate is screwed to the mandible, then removed, and the bone is resected. The plate is repositioned in the same screw holes for placement of the bone graft.

Mandibular Resections: Prothetic considerations

Processed Bases for the maxillofacial patient

In the maxillofacial prosthetic patient who has loss of supporting bone, unusual intraoral contours due to resection and reconstruction, and gross malposition of occlusal contacts, processed bases are necessary to determine occlusal plane, buccolingual tooth position, lip support, esthetics, and occlusal records.

The mandibular trial base for the maxillofacial patient often requires blockout of the trial base at he periphery of the base where unusual undercuts exist. In this way the border extension is decreased, decreasing surface area needed to optimize retention and stability of the prosthesis. It does not allow determination of the relationship of the final prosthesis periphery and the buccal or lingual tooth position.

Patients with mandibular resection and reconstructions often require the prosthesis to compensate for loss in alveolar bone quantity or the deviation/ rotation that exists in the postoperative position of the mandible. Extension beyond the peripheries of the prosthesis may be required to support the lip. To add stability to the prosthesis, occlusal contact may need to be significantly buccal or lingual to normal anatomic landmarks that usually denote the occlusal table. Bilateral support in the mandibular arch may be nonexistent due to the lack of bony reconstruction, and bilateral tooth contact might be nonexistent due to rotation of the mandible.

Even though the mandible has the surgical defect, processed bases should be employed for the edentulous maxilla because unusually inter arch relationships, such as unilateral contact on the maxilla, can unseat the maxillary prosthesis.

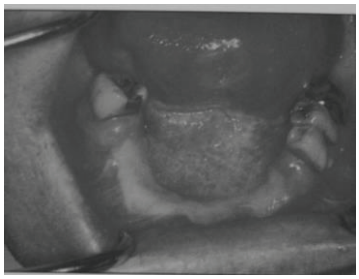
Processed bases: Technique

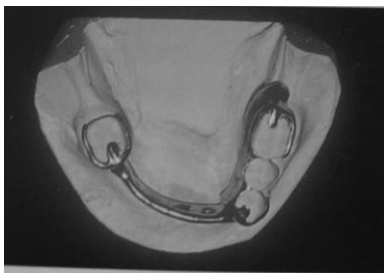
The bases can be waxed on the master cast and processed in acrylic resin. The processed bases should be taken to the mouth and evaluated for retention and overextension. Remount casts will be required. This remount cast will be used for subsequent records, to set teeth, and to adjust occlusal processing errors.

Marginal mandibulectomies

The ideal prosthesis-bearing surface for the marginal mandibuletomy patient is the split-thickness skin graft; it is thin, firmly attached to the mandible, and will not move with movement of the tongue, floor of the mouth, or check.

If the patient is edentulous a skin- grafted mandibular surface is critical for increased surface area and stability of the prosthesis. When this site is closed primarily, a denture cannot be placed over the mobile tissue because the denture will be unseated. When there is considerable height between the remaining ridge and the resection, a skin grafted surgical defect may crate a concave contour that can actually offer lateral stability to the prosthesis.





A large open lattice can be waxed to a height of several millimeters. The design can be narrow so as not to impinge on the buccal or lingual width of the mandible, but the vertical height offers strength to serve as a major connector.

Maxillomandibular Relationship Records:

Routine recording materials can be used for the marginal mandibulectomy patient. Centric relationship records should be possible because the temporomandibular system is not compromised with surgery.

The occlusal plane may be minimally modified to decrease tooth display, but gross modifications may lead to check, tongue, or lip biting.

Optional surgical prostheses:

An acrylic-resin interim partial denture can be fabricated from the presurgical impression and relined with tissue conditioner upon removal of the surgical stent. The defect will initially appear wide, but the lateral borders of the defect will contract to the width of the cut mandible.

Discontinuity Mandibulectomies

A universal prosthodontic axiom for the edentulous discontinuity mandibulectomy patients is that prosthesis should not extend onto mobile tissues that are unsupported by bone.

The most common observation patients who have unilateral discontinuity mandibular defects are the characteristic deviation of the mandible to the surgery side and rotation of mandible inferiorly. It actually shifts laterally to a greater extent at the anterior dentition and less at the second molar. The shift to the defect side is also greater as the mandible opens. Centric relation occlusion does not exist because only one condyle is functioning to guide the mandible.

Patients often have an Angle Class II appearance. Due to the deviation and rotation of the mandible, the chin is in a slightly lateral position therefore, the projection of the chin is decreased.

Palatal Augmentation Prostheses:

Patients who have mandibular resections often have difficulty valving the tongue against the palate for appropriate speech sounds or to manipulate the food bolus in mastication and swallowing.

All mandibulectomy patients should be considered for palatal augmentation prosthesis if they have residual food on the palate or in the sulci of the oral cavity, complain of swallowing difficulties, or have impaired speech sounds. This prosthesis involves shaping the contours of a palatal baseplate, either retained by the maxillary dentition or integrated into the base of a maxillary complete denture. In a normal tongue-palate

relationship, the palate cups around the tongue at rest and in function. The contours of the palatal augmentation should also cup around the residual tongue. In dentate patients, the occlusal vertical dimension will determine the thickness is increased until the tongue contacts the palate in swallowing. Where tongue bulk is lacking, wax will likely be thicker in the corresponding area of the prosthesis to gain tongue contact. Contact can be checked on the palate by pressure indicating paste. The lateral border of the palatal cup will occur at the most lateral position of the residual tongue. During speech, air may leak laterally along the borders of the deviated tongue. These areas can often be visualized as saliva escapes where the palate does not cup the tongue during speech. Slight additions of wax should be made to the augmentation to stop the lateral air escape during the sound.

The Dentate Patient

Since the dentate patient has only missing dentition on the respected side of the mandible, a mandibular prosthesis is not usually required to replace lost posterior teeth nor on unsupported soft tissues.

Mandibular deviation and rotation can cause occlusal disharmonies that result in an increased vertical dimension, inability to close lips and anterior negative overlap.

If mandible is deviated such that contra lateral dentition is palatal to maxillary dentition, a palatal prosthesis can be fabricated that creates an occlusal table palatal to maxillary table. A processed base plate with wire retention, which covers the palate and plates all of the palatal aspects of the maxillary teeth up to the level of the occlusal plane, should be fabricated.

The final occlusal table is formed with soft wax, and the patient is instructed to make repeated closures into it. Excess wax can be trimmed from the area and the wax reheated to establish contact points. The contacts may be quite broad, and there may also be slide of the mandible from initial contact to final maximum contact.

Mandibular Prosthesis

Processed bases are ideal for the edentulous patient because prosthesis- support surface area is limited. The record is made at the established vertical dimension of occlusion. The patient's path of closure is not hinge motion, rather a diagonal path in the sagital plane.

Maxillomandibular records

Determining the vertical dimension of occlusal should rely on lip competence, facial appearance, and speaking- space parameters.

The height of the anterior occlusal rim will be greater than the posterior occlusal rim and will be eliminate the negative vertical overlap. Due to mandibular rotation, the teeth on the edentulous posterior mandible will likely be set over the buccal shelf.

At the try in appointment, the entire relation is checked and repeated if needed. Multiple compromises of vertical dimension, speech, anterior teeth position and lip competence may be assesed. The palatal augmentation prosthesis should be added to the maxillary prosthesis after establishing correct tooth positions. The dentition and augmentation can be processed to the record bases. Insertion is done after proper trimming and polishing.

Cheng said that mandibular resection which results in bilateral lingual undercuts can be minimized by using a surgical splint fabricated from a presurgical mandibular cast.

The presence of excessive lingual undercuts after mandibulectomies and surgical reconstruction is a challenge. Preprosthetic surgical correction of lingual undercuts is a viable option but history of therapeutic radiation therapy may also contraindicate additional surgery of the affected jaw. The goals include providing lip support, improving articulation, reducing drooling and regaining favorable esthetics. A hinged mandibular removable complete denture can be considered in such cases.

Procedure

1. Fabricate two sectional mandibular final impression trays from the diagnostic cast. Construct key and keyway attachment mechanism at the impression tray handles.

2. Border mold the sectional trays. Make sure the border molding material does not interfere with the keyed handles of the sectional trays. Make the final mandibular impression one section at a time with elastomeric impression material.

3. Remove excess impression material at the junction of the two sectional trays. 4.Align the sectional impression trays using the keys on the tray handle. 5.Assemble the sectional impressions and bond the halves together with cyanoacrylic cement at the key handle. Pour the final mandibular impression in type V dental stone.

6. Apply two layers of baseplate wax on the mandibular stone cast.

7. Process the denture base in clear heat-polymerization acrylic resin, then deflask, trim, and polish.

8. Fabricate a stone index for the tissue side of the lingual surface of the mandibular denture base.

9. Section the mandibular denture base between the central incisor area and reposition it on the index.

10. Fabricate a simple hinge mechanism using a stainless steel orthodontic bracket with a buccal tube and 1mm stainless steel wire. Add the custom made hinge to the sectioned area on the denture base in autopolymerized acrylic resin.

11. Confirm that the resultant hinge is unobstructed after curing the acrylic resin. Also confirm accuracy of the relationship between the sectional mandibular denture bases on the stone index cast.

12. Establish an occlusal rim on the denture base and proceed with jaw relationship records. Mount the maxillary cast and mandibular stone index in an articulator.

13. Select denture teeth and arrange the teeth on the denture base for try-in. 14.Maintain the split between the incisors in the wax denture.

15. Make a silicone index of the anterior teeth.

16. Remove the 2 denture teeth adjacent the to the hinge assembly.

17. Invest the denture and ensure the hinge assembly is fully covered by dental stone so that no acrylic resin will be processed onto the hinge assembly. 18.Process the denture in heat-polymerized acrylic resin without the two anterior teeth. Deflask, trim, and polish the denture.

19. Reposition the two anterior teeth over the hinge assembly in autopolymerizing acrylic resin using the silicone incisal index. Make certain that the split in the denture base is maintained between the 2 incisors.

20.Finish and polish the completed denture. Verify that the hinge action is free and unobstructed. At the delivery appointment, the patient should be instructed in the insertion and removal of the prosthesis. Oral hygiene instruction should be reinforced and routine follow-up appointments should be scheduled. After the patient is comfortable and satisfied with the esthetics and function of the prosthesis, recall appointments can be extended to every 6 months.[36]

CHAPTER 17: REHABILITATION FOLLOWING TOTAL AND PARTIAL GLOSSECTOMY

By Dr. Surendra Kumar Acharya

The primary function of the tongue is swallowing; its secondary function is speech. Both functions are complex in nature and require integrated voluntary and involuntary muscle coordination. Alteration of these functions may result from trauma, neurologic deficits, or surgical interference such as tumor removal.

Prosthodontic Treatment of Total Glossectomy

Tongue defects due to tumor removal can result in either total or partial glossectomy. A total glossectomy will create a large oral cavity with loss of oral communication and pooling of saliva and liquids. These liquids can seep around the epiglottis, leading to aspiration. Surgical closure of laryngeal opening may reduce the incidence of aspiration and aid the patient in swallowing liquids.

The major goals in prosthodontic rehabilitation of the total glossectomy patient without surgical reconstruction are to: [104]

1.Reduce the size of the oral cavity, which improves resonance and minimizes the degree of pooling of saliva.
2.Direct the food bolus into the oropharynx with the aid of a trough carved into the dorsum of the tongue prosthesis.
3.Protect the underlying fragile mucosa if skin flaps were not used.
4.Develop surface contact with the surrounding structures during speech and swallowing.
5.Improve appearance and psychosocial adjustment.

The success of prosthodontic rehabilitation depends primarily on patient motivation, anatomic factors (such as the presence or absence of teeth), and the associated morbidity of the surrounding structures, including

mandibulectomy, palatectomy, and radiation therapy to these areas. In total glossectomy, the mandibular tongue prosthesis is the treatment of choice.[105]

However, in a situation involving an edentulous patient and an irradiated, resorbed mandibular ridge or a patient with a very mutilated dentition, a palatal augmentation prosthesis should be considered. These can be refined with the use of multiview videofluorscopy, vediotaping, and spectrographic analysis.

Speech considerations in prosthodontic rehabilitation of the glossectomy patient

A breath stream that passes through a vibrating mechanism, a resonating system, and a partially or totally occluded cavity produces human speech. Speech sound (phoneme) production results form lengthening shortening, and constricting the flexible tube known as the vocal tract. The amount and portion of tongue resected is directly correlated with speech intelligibility. The loss of the tip of the tongue is more critical to intelligibility than a hemiglossecotmy. Partial glossectomy speakers can often use the residual tongue stump to perform adaptive movements that approximate normal movements and should be treated as an articulation problem.

Sound affected by glossectomy

The degree of articulation impairment in glossectomy patients is dependent on the extent of tissue loss. In a patient with minimal tissue loss, speech intelligibility may not be impaired.[106]

Kalfuss found 12 phonemes, which included 11 consonants and one vowel (i), to be most impaired.

Skelly et al studied the speech of 14 total and 11 partial glossectomy patients. They found that partial glossectomy patients used the residual tongue stump to perform adaptive movements similar to normal articulatory

movements, whereas total glossectomy patients development truly compensatory patterns of speech.

Cantor et al found that the degree of movement of the residual tongue also affected speech intelligibility. They studied 10 patients, five of who had severe restriction of tongue movement and five of who had moderate restriction. Severe restriction was defined as inability to contact either the palate or the maxillary teeth with the residual tongue. With moderate restriction, partial or infrequent contact with the teeth or palate was possible during speech.

The vertical axis or dimension of tongue placement may be critical relative to the status of the remaining dentition. In glossectomy patients who are dentulous or partially edentulous, the teeth determine the vertical dimension of occlusion. Occlusal contact maintains the volume of the oral cavity and limits resonance control by compensatory adjustments of the mandible. Patients with natural tooth occlusion tend to have poorer articulation than patients who are edentulous. Edentulous patients can affect greater control over the resonance of the oral cavity by compensatory closure of the mandible. This does not impinge on the vertical dimension needed for resonance modification.[13]

Construction of mandibular total tongue prosthesis

A stock plastic maxillary tray of proper size should be selected. The maxillary tray is necessary to register the entire floor of the mouth. The tray is loaded with irreversible hydrocolloid and positioned intraorally. After the hydrocolloid material has set, the tray is removed inspected, and poured in artificial stone.

The preliminary cast is surveyed and mouth preparations in the form of occlusal rest seats and guide planes are planned. Mouth preparations are executed in the patient's mouth. The teeth are polished and the final impression is made and is poured in improved artificial stone. All

undesirable undercuts are blocked out and the area of the floor of the mouth is relieved with at least two thickness of baseplate wax before duplications the master cast to the refractory cast.

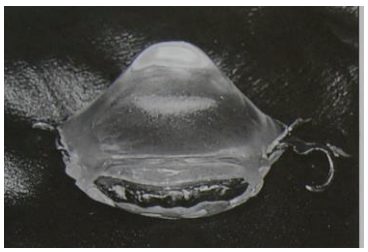
The wax pattern of the glossectomy framework is finished, sprued, invested, cast in chrome cobalt alloy, and polished following conventional techniques. Care should be taken to ensure that the retentive meshwork does not touch the floor of the mouth during any functional movement.

A layer of sticky wax is luted to the retentive meshwork of the RPD framework. This layer of sticky wax is then covered with a layer of mouth-temperature softening wax and then placed in the patient's mouth. The patient is asked to perform functional movements with the floor of the mouth such as attempting to pronounce various sounds, opening and closing, and attempting to swallow.

After complete tracing of the floor of the mouth, the framework is invested. A mushroom like projection is waxed to the oral surface of the framework to retain the oral portion of the tongue prosthesis. Investment procedure is completed and the prosthesis is processed in heat- cured acrylic resin. The prosthesis is then retrieved, finished, and polished

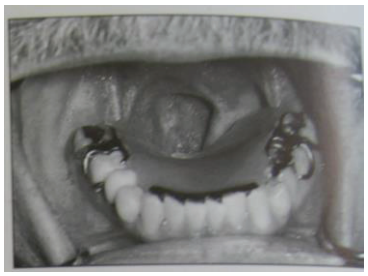
It has been suggested that three prosthetic tongues be made: one for speech, one for swallowing, and one for both.[105]

The prosthetic tongue for speech should have an anterior elevation to facilitate articulation of the anterior linguoalveolar sounds t and d. It should also have a posterior elevation to aid in the articulation of the glottal stops or posterior linguoalveolar sounds g and k. Both elevations help to shape the oral cavity, thus improving vowel production in general.



Prosthetic tongue for speech

The prosthetic tongue for swallowing is waxed in the form of a sloping troughlike base in the posterior aspect to help guide the food bolus into the oropharynx. It is then processed in denture base acrylic resin. Both types of tongue prosthesis may be fabricated as interchangeable speech and swallowing prosthesis attached via the retentive button on the base portion of the prosthesis.



Prosthetic tongue for swallowing

In some instances, the mandibular tongue prosthesis can be constructed to include both features of swallowing and speech in a highly motivated patient. A heavy mix of Coe-comfort tissue- conditioning material is added to the base and the patient is asked to move the mandible while pronouncing t, d, k, g as the material sets. Add or remove material during this procedure until the desired sounds are attained. A trough like groove is created in the posterior middle aspect of the traced tongue.

Comfort tracing is then removed and duplicated in silicone with appropriate intrinsic mushroom like projection of the acrylic resin base.

Marunick and Nicholas describes the efficacy of palatal augmentation prostheses for speech and swallowing in patients undergoing glossectomy.[44]

The palatal augmentation prosthesis (PAP) has been defined by the Glossary of prosthodontic terms as a palatal prosthesis that allows reshaping of the hard palate to improve tongue/palate contact during speech and swallowing because of impaired tongue mobility as a result of surgery, trauma, or neurologic/ motor deficits. When using the palatal augmentation prosthesis, the palatal vault is re-established at a lower level than normal, requiring less bulk and mobility of the tongue for appropriate palatolingual

contacts during speech and swallowing. The purpose of this prosthesis is the restoration of function. It is incapable of replacing the tongue.

Because of the extent of the surgical procedures and potential risk for aspiration, a rational approach is required in the treatment of patients with these defects. This approach includes an assessment of swallowing by a speech pathologist via videofluoroscopic barium or modified barium swallows or scintigraphy to determine the risk for aspiration and safety of attempting to restore swallowing with prosthesis. If the patient can swallow safely (without risk for aspiration), improvements in mastication, swallowing, and speech may be reasonable goals for treatment. If the patient is at risk for aspiration, he or she will continue to depend on a gastric tube for nourishment and an improvement in speech alone or speech and esthetic may be reasonable goals for treatment.

Palatal Augmentation Prosthesis technique

In dentate or partially dentate patients, a maxillary framework is designed following conventional prosthodontic techniques with an added midpalatal meshwork to retain the augmentation portion of the prosthesis.

A thick mix of tissue-conditioning materials is added to the palatal portion of the maxillary denture. While the material is still moldable, the patient is instructed to swallow and pronounce certain phonemes. He is asked to repeat the linguovelar sounds /k/and /g/ for the posterior palatal tracing and linguoalveolar sounds/t/ and/d/ for anterior palatal tracing. Pressure indicating paste is used to show the area of contact. Modeling compound can be added to improve contact where indicated, and the final tracing is made with a functional wax. If articulation is acceptable for most elements of speech, except linguoaveolar fricatives /s/ and /z/, a narrow groove can be placed in the midline of the anterior portion of the prosthesis to improve the production of these sounds. The same procedure can be used for the edentulous patient using the patient's existing denture.[13]

A plaster matrix is fabricated and the tissue-conditioning material is replaced with autopolymerized acrylic resin. The denture is returned to the mouth and tested again for speech and swallowing.

They hold together the segments of fractures, hold the skin grafts, and protect the healthy tissues while administering radiotherapy. They are used to control possible hemorrhage, to hold periodontal packing, to protect the denuded necks of teeth, to help in drainage of periodontal infections, and to prevent the healing and accelerate the eruption of unerupted teeth.

Splints

Gunning Splint: This prosthetic device is usually constructed for an edentulous mouth to hold together fractured segments of mandibular or maxillary bones and to immobilize the jaws in occlusion. In the once piece Gunning splint, upper and lower baseplates are joined in a proper vertical and centric relation with a bite rim.

In the two-piece Gunning splint, separate splints are constructed for the maxilla and the mandible.

Modified Gunning Splint: If the patient has complete maxillary and mandibular dentures, the incisors can be removed and used as splints with the addition of interdental wires.

Labiolingual Splint: They are constructed for dentulous or partially edentulous arches to aid in reduction of fractures.

The splint consists of an acrylic band that fits around the labial and lingual aspects of the teeth, leaving the occlusal surfaces of the teeth uncovered. The labial flange is split into two sections from the midline or from another suitable area. This type of splint is ideal for cases with exostosis, for there is no need of blocking out the undercuts.

Fenestrated Splint: This is one-piece prosthetic device which is contoured to fit a dentulous maxilla and mandible through fenestrations created for the occlusal surfaces of the teeth. These types of splints are used of short permanent

clinical crowns, for deciduous teeth when no undercut is available for retention, and for badly decayed teeth, as in postradiation caries.

Kingsley Splint: It is often constructed for dentulous or edentulous patients, covers the palate and the ridge. It has an anterior extension of metal rods protruding bilaterally from the commisures of the mouth. It is especially useful in raising a fractured maxilla.

Case Metal Splints: This splint may be capped or left open at the occlusal surface, or it may also be hinged.

Stents

Antihemorrhagic Stent: A prosthetic device can be constructed with methyl methacrylate, lined with a hemostatic agent, and inserted in the mouth immediately after surgery to control possible bleeding.

Occlusal Stent: Occlusal stents or bite plates may be adapted to either the mandibular or maxillary arch, the primary function of the occlusal stent is to disengage the occlusion temporarily and to interrupt existing patterns of muscle function, which contribute painful myospasm.

Dynamic Bite Opener (Trismus Stent, Temporomandibular joint Exerciser): It is a combination of maxillary and mandibular occlusal stents with rod bows coming out from the commissars of the mouth to exercise the temporomandibualr joint or to open and close the mouth.

Drainage Stent: It can be constructed on a pre-existing partial or complete removable denture by modifying the prosthesis in the appropriate area to facilitate the securing of the drainage tube.

Pedodontic Stents: A methyl methacrylate stent is inserted in the mouth to prevent the healing of uncovered tissue and to facilitate eruption of the impacted tooth.

Intraoral Stent for the physically handicapped: This interocclusal stent is designed for aiding the patient in drinking and sucking in nourishment.

Periodontal Stent: It holds the periodontal dressing in place during the healing phase.

Labial Periodontal Stent: A thin labial stent of gingival tissue-toned and characterized acrylic can be made to disguise the elongated crown root appearance seen in a side smile. The area of the stent to be covered will be from the distal of the second bicuspid on the opposite side.

Stent for Use Mucous Membrane Advancement or Skin Graft Protection: When an edentulous ridge is to be deepened by vestibular surgery, the wound area must be prevented form reattaching to the ridge during healing. When a skin graft is placed in a vestibule, palate, or floor for the mouth, it is helpful to the patient and surgeon to cover it during the healing phase for protection of the graft, immobilization of the medicated dressing, and patient comfort.

Mouth Protector: An oral mouth guard stent for protection of the teeth is recommended when: (1) an individual engages in contact sports; (2) maxillary anterior fixed bridgework or crowns are present and the patient is to enter surgery under general anesthesia; (3) the patient engages in bruxism during the night; (4) an adverse habit prevails which threatens the teeth periodontally; (5) the patient is a mouth breather; (6) a periodontal pack needs to be placed more securely.

Radiation Stents: A radiation stent must perform the following functions; position diseased tissues in a given repeatable position throughout the treatment process reposition or protect by shielding undiesed tissue so as to remove it form the radiation field position the radiation beam in a given position carry radioactive material or dosimetric devices to a site recontour certain areas so that therapy can be simplified.

CHAPTER 19: OCULAR PROSTHESIS By Dr. Desh Deepak

Patients requiring treatment with custom ocular prostheses are those who lost ocular structures through orbital evisceration or orbital enucleation.

A fundamental objective when restoring an anophthalmic socket with an ocular prosthesis is to enable the patient to cope better with the difficult process of rehabilitation after an enulceation or evisceration. The placement of an ocular implant provides additional anatomic support for the residual contents of the orbit, increases motility, of the overlying ocular prosthesis, and provides muscular stimulus for orbital growth.[30]

Patient Evaluation

The evaluation should include a physical and psychological appraisal of the patient, including the desires and expectations of the patient related to the proposed prosthesis. Patients should be counseled regarding expected results, with specific emphasis on their role both during the treatment phase and after completion of the prosthesis.

The patient will usually present for treatment with either the conformer or an existing prosthesis in place. The prosthesis or conformer should be removed and a thorough examination of the defect performed. The examination should include a determination of adequate healing and lack of irritation from the existing prosthesis or conformer.

Prosthetic evaluation of orbital defects[107]

A complete preoperative examination of the patient undergoing orbital examination is preferable to only a postoperative evaluation of the resultant defect. The position of the globe is determined by the integrity of the orbital walls and the ligaments suspending the eye. Removal of these structures requires a strict dependency on the remaining orbit and residual structures in prosthetic reconstruction.

Although the need for prosthetic orbital rehabilitation is based on the postoperative defect, the treatment plan should be based on the patient's

preoperative appearance. Preoperative evaluation of the patient, as with any head and neck cancer patient, provides for optimal preparation of the patient and planning of the treatment. This can greatly enhance the patient's postsurgical adjustment to the prosthesis.

The type of tumor often dictates the prosthetic prognosis and therefore the approach to prosthetic rehabilitation. The extent of surgical treatment is directly related to tumor size, extension, and tumor type. Immediate the delayed prosthetic treatment depends not only on the timing of healing of the patient, but also on the knowledge the tumor has been completely eradicated. The postoperative pathology report and the type of tumor will reveal the necessity for adjunctive or combined therapy. Tissue healing and tissue tolerance to the orbital prosthesis and to adhesives used in retention are adversely affected by both chemotherapy and irradiation.

Prosthetic approaches to orbital defects[107]

In an evisceration procedure wherein only the intraocular contents of the globe are removed, minimal prosthetic treatment is required.

In an enucleation defect treatment begins with use of implants behind the posterior layer of tenon's capsule to preserve greater volume in the orbit following globe removal. A conformer is also placed to maintain the fornices. An ocular prosthesis is then initiated approximately 10 to 15 days after surgery.

Cosmetic and functional results are dictated by extent of alteration of orbital anatomy and physiology. More favorable cosmetic results can be obtained with enucleation from prosthetic point of view, because of space limitation in eviscerated patient. An evisceration procedure provides superior esthetics from surgical point of view because the orbital anatomy is undisturbed.

Orbital exenteration involves the complete removal of the orbital contents, including the eyelids. Surgical and prosthetic prognosis depends on

the type of tumor. Skin grafting enhances prosthesis tolerance. A prosthesis is constructed after healing.

Many variations exist in techniques and materials for fabricating orbital prostheses. One of the critical steps in fabrication is the production of a mold from a custom sculpted orbital pattern. This step requires great attention to detail to produce an accurate reproduction of the sculpted pattern.[43]

Wolfaardt et al described a technique that provided a mold acceptable for fabricating duplicate prostheses. The technique creates space for the ocular portion in the wax clay pattern by removing the ocular prosthesis and pouring an improved stone into the void in the upper half of the mold.[108]

Joose et al separated the master cast side of the mold into four sections, which moulage made from autopolymerizing acrylic resin, room temperature vulcanizing silicone rubber, and a backing layer of dental stone. Two slices were cut in the acrylic resin section to allow the section to flex.[109]

Chambers et al demonstrated the use of a custom flask made of polyvinyl chloride pipe with critical parts of the mold made of autopolymerizing acrylic resin for fabricating an auricular prosthesis.[110]

A study by Jebreil reported that most patients needed their orbital prosthesis renewed every 6 to 9 months. The reason given by the patients were change in the defect, and surgical reconstruction of the defect. For the first 2 reasons, use of adhesives, routine cleaning, ultraviolet light, and air pollution all contributed in some way to degradation of color and marginal integrity. These frequent prostheses remakes require a mold that is durable to the stresses placed on the internal surfaces by acid dissolution and clastic pull when recovering the prosthesis.[111]

Common materials for mold fabrication are acrylic resin, epoxy resin, silicone, Lipowitz metal, dental stone, or a combination of these materials.

Among these, dental stone is the most commonly used. Stone molds are relatively easy to construct, accurate, and inexpensive; however, the stone is fragile in the palpebral area and susceptible to fracture during the processing. When the orbital prosthesis is fabricated from a stone mold where this breakage may have occurred, the details of this area are lost, creating difficulty in capturing the esthetic camouflage.[43]

Use of custom made conformers in the treatment of ocular defects:

The custom-made ocular conformers act as an interim measure and as valuable diagnostic indicators of problems experienced by the patients. While stock conformers merely maintain the socket size and prevent scar tissue contractures, the custom made conformers can also be used to enlarge unfavorably small sockets, stimulate eyelid movement, aid hygiene, help the clinician develop the final shape for the definitive prosthesis, and reduce the amount of post insertion adjustments needed. These advantages and the case of fabrication make custom made conformers a viable initial treatment option in patients with ocular defects.

The loss of an eye, whether as a result of surgical enucleation or trauma, is often followed by sear tissue contracture this may be accompanied by eyelid constriction, reduced socket size and depth, eyelid incompetence, and decreased residual muscle movement. These physical deformities, along with social and psychologic discomfort, often prompt the patient and the clinician to consider an immediate prosthetic replacement.

Early provision of a definitive ocular prosthesis often presents problems. There may be upper eyelid ptosis, which if persistent, needs surgical correction, or pseudoptosis, which can be corrected by increasing the volume of the prosthesis to support the upper eyelid. This leads to poor prosthesis retention, and may need surgical correction with the use of skin grafts to create anatomic tissue under the use of skin grafts to create anatomic tissue under cuts to enhance the fitting surface of the socket bed resulting in a change of orientation of the iris.

Ocular prostheses often settle and sink into the socket in the first few weeks after being fitted, which may cause sagging of the lower eyelid. This is exacerbated by the weight of the prosthesis as well as the contraction force of the upper eyelid. These problems may result in timely and costly remakes being required.[112]

Beumer advocated placing a plastic stock conformer immediately into the socket to fit the contours of the cavity and to fill the depths of the fornices. These were to be left in place while healing occurs to reduce edema and to maintain the socket contours for the definitive prosthesis.[2]

The custom made conformers, had the added advantage of being easily modified or adjusted where needed before the definitive prosthesis was fabricated and to allow the clinician time to assess patient adaptation and compliance.

Placement of a conformer minimizers changes in the socket size and conformation and prevents scar tissue contractures from distorting the socket bed. It also allows for clinical assessment of retention, eyelid competence, and residual muscle movement. If further surgery is needed to deepen the socket bed or alter the eyelids, the socket is enhanced by using the conformer as a surgical stent to maintain the mucosal grafts in position and support the fornices.[107]

Early settling and sinking occurs with most patients so that modifications to their conformers are required to maintain an esthetic appearance and adequate eyelid support. Custom made conformers, versus stock conformers, required minimal alterations to accommodate initial changes in the socket and surrounding soft tissues. Such adjustments are not possible on ocular prostheses, as they tend to alter the iris position.

Where the socket depth is already reduced because of scar tissue contractures and surgery is not feasible, a custom made conformer can be readily increased in size by addition of acrylic resin or an orthodontic spring

opener to actively stretch the socket. Once the socket has been increased to an acceptable size, a definitive ocular prosthesis can be fabricated. Stock conformers often require elaborate, time consuming adjustments. The presence of the custom made conformer and its close approximation to the tissues in the socket, stimulates the eyelid muscles to move, thus, exercising them and preventing disuse atrophy. Socket conformers lack a close fit and therefore cannot stimulate eyelid movement.

Drawbacks

Fabrication of a custom made conformer necessitates a number of appointments before the fabrication of the definitive prosthesis. This places a time burden on the patient and the clinician that increases the total cost for the patient. Some patients find the initial esthetics of a custom made conformer insufficient to meet their needs.

Sykes, Essop and Veres describes a procedure for fabrication of conformers.[112]

Procedure

1.Anesthetize the socket with 1 or 2 drops of topical anesthetic.

2.Select an ocular special tray of the appropriate size and try it into the socket to verify the fit. (If the special tray is not available, a tray can be fabricated at the chair side by heating a small piece of modeling compound and adapting it to the area around the eye or around a small rubber ball. This should be kept as thin as possible (2 to 3 mm).

3.Place a small tube in the center of the compound and lute it into position with sticky wax. The addition of a few small holes in the wax aids retention of the impression material.

4.Mix unflavored ophthalmic grade irreversible hydrocolloid material to a runny consistency by adding 1.5 parts warm water to 2-part powder. The warm water speeds up the setting time.

5.Inject the hydrocolloid down the tube into the socket under slight pressure while supporting the tray in position, and then allow the impression to set.

6.Remove the impression and use it to pour a 2-piece split cast mold that is used to fabricate the acrylic resin conformer.
7.Once fabricated, the conformer can be fitted immediately and adjusted at the chairside where needed, thus not allowing time for the socket to shrink and scar tissues to contact.
8.Dismiss the patient with instructions to wear the conformer continuously and only to be removed for cleaning. Severe pain or discomfort must be reported immediately to ensure that necessary adjustments can be made.
9.Once the clinician and patient are satisfied with the size and conformity of the conformer, and the socket is well healed and dimensionally stable, a conventional, definitive ocular prosthesis can be manufactured.
10.A duplicate of the modified conformer in wax can be used as a template for the definitive prosthesis.

Ocular prosthesis

Impression and Wax Pattern Fabrication

The defect should be anesthetized with 0.5% tetracaine hydrochloride ophthalmic solution topical anesthetic to increase comfort during the impression procedure. One or two drops of the solution should be placed onto the conjunctiva of the defect and allowed to take effect for about 15 minutes.

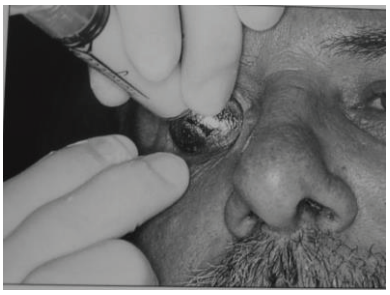
The most common techniques are the **molded shell or stock ocular tray** technique and the **external tray** technique.

> The molded shell technique utilizes a stock ocular impression tray and works well for the vast majority of surgical enucleation and surgical evisceration situations, but it has the potential of creating an over extended impression.

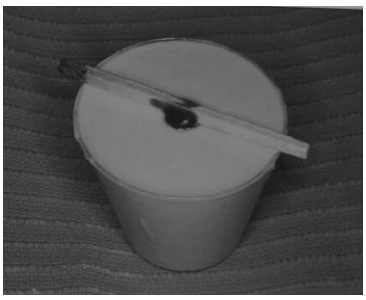
The external tray technique is particularly useful for patients with less desirable morphology of the defect, usually as a result of trauma, infections, or complications during healing, as there is no tray placed within the defect.

Stock Tray Impression Technique

An impression is made of the ocular defect using stock ocular tray and nonirritating impression material, ie, ophthalmic quality irreversible hydrocolloid. During the procedure, the patient should be seated in an upright position with the head supported by the headrest. This position allows the natural positioning of the palpebrae and surrounding tissue relative to the force of gravity. The stock tray should be placed into the defect before making the impression to determine the proper orientation and fit without overextension.



Fit of stock tray checked



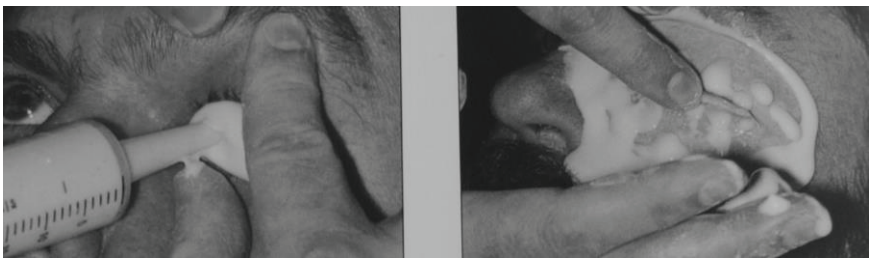
Silicone wax pattern mold

The tray-syringe assembly should be oriented so that the stem of the tray is parallel to a line perpendicular to the pupil plane of the natural eye. The tray should be oriented to support the lids in a similar position to the lids of he natural eye. Ophthalmic quality irreversible hydrocolloid is mixed and loaded in the syringe, and sufficient material is ejected to fill the concavity of the tray. The tray is then reinserted and reoriented in the defect; sufficient material is injected to elevate the lid contours similar to the normal side. The patient is instructed to look to the right, left, up, and down without moving the head. If the impression was properly oriented and extended into all available areas, the stem of the tray should follow the movement of the pupil of the natural eye. If the tray and syringe were properly oriented during the impression procedure, the location of the stem on the frontal surface of the scleral pattern becomes a starting point for the orientation of the lens button assembly.

After an acceptable impression of the eye socket has been obtained, it is reproduced in wax. This assembly is suspended over a small medicine cup, and room-temperature vulcanizing silicone mold material.

External Tray Impression Technique

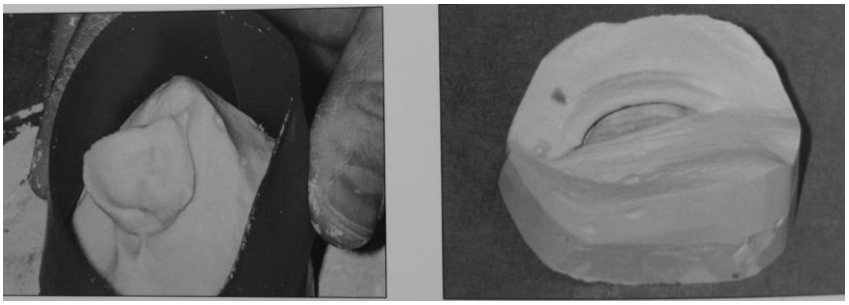
Alginate impression material is mixed and expressed into the defect under the lids while the patient gazes directly forward at a fixed point at least 6 feet away. This will allow impressioning of the site with the muscles captured in a neutral gaze position.



Ocular impression is syringed

External ocular impression tray placed

Next a perforated acrylic-backing tray is loaded with alginate and placed over the defect, and the material is allowed to set while the patient maintains a neutral gaze. Once set, the impression is removed by having the patient wiggle the face to break the seal. The impression is removed from the lower, shallower sulcus first, and then rotated out of the deeper, upper sulcus. The impression is boxed and poured in dental stone upto the height of contour of the impression of the defect. A separating agent is place and the remainder of the impression is poured. Once set, the cast can be trimmed on a model trimmer.



Molten wax poured into cast

Upper half of cast sectioned

The cast is reassembled and the defect site filled with molten baseplate wax. Once the wax has solidified, the cast can be separated and the upper half sectioned to within about one-eight inch of the medial and lateral canthus with a coping saw. The cast can then be fractured and the wax pattern retrieved. The sprue can be removed with a sharp scalpel and the anterior surface of the wax pattern smoothed with a flame.

Scleral wax pattern in place

Fitting the scleral wax pattern

The fit of the pattern is observed by gently lifting the lids and observing the extension into the fornices. Areas of underextension may be corrected by adding baseplate wax or hard impression wax. The support and contour afforded by the scleral pattern may be compared visually with the patient's eyes open and by bimanual palpation with the eyes closed. Wax is added or trimmed from the basic scleral pattern until satisfactory contours of the eyelids are achieved, both in open and closed positions.

Custom made Ocular Prosthesis

Ow and Amrith says that the custom-made acrylic resin ocular prosthesis achieves intimate contact between prosthesis and tissue bed. The close adaptation of the custom made prosthesis tends to distribute pressure more equally than does stock eye prosthesis. This helps reduce the incidence of conjunctival abrasion or ulceration. It also enhances tissue health by reducing potential stagnation spaces at the prosthetic tissue interface. Fluid collection in the space could cause tissue irritation and increase bacterial growth.

Indications

The indication for a custom made ocular prosthesis includes a postsurgical socket with a suitable tissue bed. The socket exhibits a healthy and intact conjunctival epithelium deep fornices, and taut eyelids. An ocular implant, if place within the sclera, is under the influence of attached extracular muscles after evisceration. Alternatively, the implant is placed within connective tissue after enucleation. There may be occasions when the shrunken eyeball is left in situ, a condition known as phthisis bulbi. This allows some degree of limited movement of the ocular prosthesis.

Contraindications

The custom made ocular prosthesis may be contraindicated when an undue change in socket volume has taken place. A loss of socket volume may arise from conditions such as anopthalmos, microphthalmos, or tissue shrinkage due to noncompliance in the use of an ocular prosthesis by a growing child. Socket expansion, which uses prosthesis devices of progressively larger sizes over an extended period, are used in these cases.

An excessive increase in socket volume may arise from postenulceation sequelae. These involve several characteristic features such as the presence of a deep superior fornix, superior lid ptosis, sagging of the inferior lid, and lateral canthus. Other features include posterior and inferior migration of an existing ocular prosthesis, loss of attachment, and migration of the ocular implant. Surgical correction is needed to reduce excessive socket volume in these circumstances.[30]

Fabrication of custom ocular prosthesis

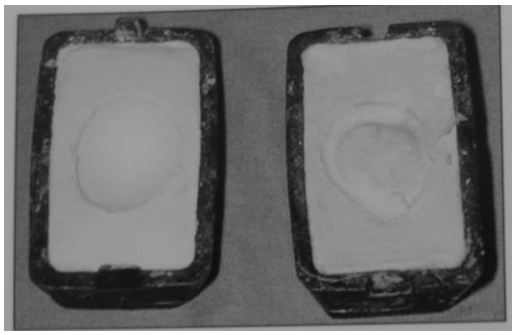
The most common techniques for custom ocular prosthesis fabrication are the paper iris disk technique and the black iris disk technique.

The paper iris disk technique utilizes readily available materials and techniques familiar to the dental office and allows almost limitless adjustment of coloration.

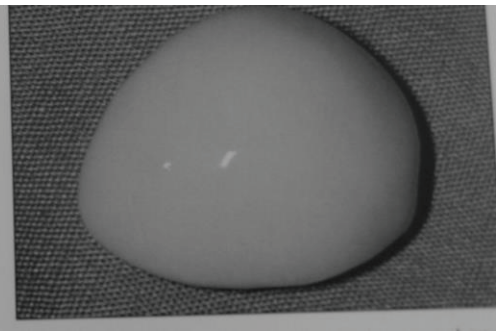
The black iris disk technique requires significantly greater mastery of color matching and painting skills but produces a three-dimensional value to the resulting iris-lens assembly because of a laminating effect in the painting process.

Paper Iris Disk Technique

When the wax pattern is determined to be appropriate, it is flasked and processed in scleral resin. The scleral blank is then finished, and it is polished using pumice and acrylic resin polish.



Completed mold with space created by wax pattern



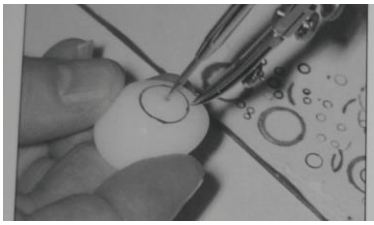
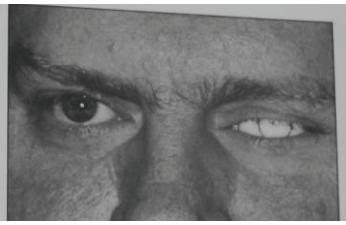
Anterior surface of processed and polished scleral blank

The scleral blank is tried in and the middle of the pupil is marked while the patient gazes directly at the clinician. The outline of iris is then marked on the scleral blank using Carmen red ink. This ink will transfer to the investing stone, facilitating the appropriate placement of the corneal prominence. The blank is then invested to allow final processing of prosthesis after coloration. It is important that the iris circle be invested as

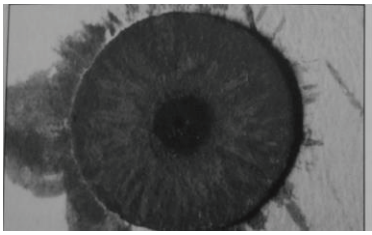
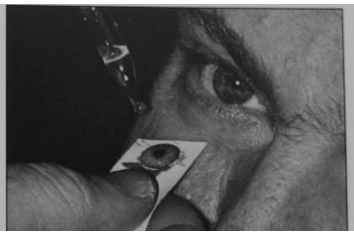
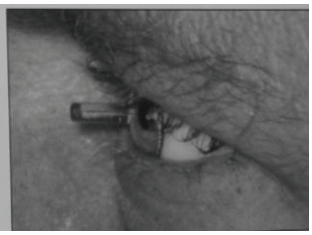
horizontally as possible to prevent movement of the iris painting during final processing. The location of the iris will transfer to the investment.

Using artist's acrylic paint the disk is painted to match the coloration of the natural iris. A good selection of colors for this purpose includes ultramarine blue, burnt sienna, burnt umber, yellow oxide, titanium white, and mars black. It is important to use a thin brush and paint many brush strokes form the center of the disk to the periphery. Colors should be mixed and reapplied in a layering fashion to mimic the colored striations in the patient's iris. Color of the iris painting under a drop of water is compared to the natural eye.

Using an ocular blank to survey the appropriate gaze of the prosthesis the scleral blank is adjusted until the handle of the blank coincides with the view of the normal pupil. Blood vessel fibers are coated with monomer-polymer syrup to hold them in place for processing. Scleral blank with iris painting is placed in the flask, clear resin is packed and ready for trial packing. Once polymerized, the prosthesis is trimmed and polished using pumice and acrylic resin polish.


Iris marked on scleral blank Size and location verified Corneal prominence created

Completed iris painting Color of iris matching Adjustments done

Black Iris Disk Technique

The natural eye is observed closely and the diameter of the iris is estimated using a millimeter measurement gauge or optical scale. An iris disk approximately 0.5 mm smaller than the actual measurement should be selected, allowing for magnification of the iris by the clear acrylic lens. The lens buttons are prefabricated in corresponding sizes with various size jet-black pupil disks incorporated in the center of the flat surface.

The positioning of the iris-lens assembly on the wax scleral pattern is perhaps the most important phase in fabrication of the prosthesis. The patient should be seated comfortably in an upright position without the back or head supported.

The position of the iris-pupil area of the natural eye in relation to the inner canthus and the upper and lower lids is then transferred to the scleral pattern. The pattern is then removed from the socket and a cylindrical portion of wax slightly larger than the lens button and approximately 1 to 2 mm thick is removed from the marked area. The lens button is then attached in the depression on three small cones of soft utility wax. Sharp corners must be smoothed with a wax instrument prior to replacement of the pattern in the eye socket.

Placing a point light source 3 to 6 feet in front of the patient and instructing the patient to fix his or her gaze on the light may check the positioning of the iris-lens assembly. The reflection of the light in the natural eye and the artificial eye should be the same when proper alignment is achieved.

Zaki uses a modified facebow to verify the position of strategic landmarks during reconstruction.

Procedure: A slidematic ear face bow was modified by attachment a second anterior reference pointer to the bow. Each pointer had the exact relation to its corresponding ear face. This created a face bow with two

pointers that have the same relation to the midline and to its corresponding piece. Strategic markings were placed on the nondefct side with the help of a ruler and indelible marker. The sidematic ear face bow was then placed on the patient's face with one of the anterior reference pointers that touched the marking and this pointer was then locked. The now was the removed and reversed on the face of the patient so that the second pointer would touch the same marking and then it was locked. The slidematic ear face bow was ready to verify the final carving of this landmark. The same procedure can be repeated to verify other strategic landmarks, such as the level of the outer and inner canthus of the eye and the ala of the nose in relation to the midline.[27]

After assesing proper alignment, the pattern is the carefully removed form they socket without movement of the lens assembly. A hot-wax instrument is used to flow baseplate wax under the lens assembly to prevent further movement.

The finished pattern is then invested in a small two-piece brass flask. The bottom half of the flask is filled with improved stone, and the tissue surface of the pattern is painted with stone and placed in the flask to the height of curvature of the edge of the pattern. After a sufficient setting time has elapsed, the stem of the lens assembly is covered with tin foil and the stone is painted with a foil substitute solution. The second half of the flask is poured. After the stone has set, the wax is removed from the mold by boiling, the lens assembly and the mold is painted with foil substitute. Any sharp, thin areas of stone at the edge of the mold should be removed to prevent breakage and incorporation into the prosthesis. The mold is allowed to cool to room temperature before packing with white scleral acrylic resin. The ocular prosthesis is removed from the mold after curing and carefully trimmed of all flash using sandpaper disks or arbor bands. The surface is finely polished using pumice. A high gloss-polishing compound is used to achieve the final finish, and the prosthesis is thoroughly scrubbed with soap and water and examined for surface imperfections, preferably under magnifications.

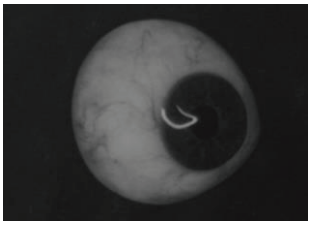
Tissue conditioner can be used as an impression medium for prosthetic mdification of an ocular prosthesis. The main advantage of the tissue conditioner as an impression medium is its biocompatibility in relation to the anophthalmic socket. The custom made ocular prosthesis, modified by a tissue conditioner impression medium in situ, provides a comfortable and healthy clinical soft tissue response. Its biocompatibility allows the continued clinical use and the evaluation of the ocular prosthesis, over an extended period. The method is suited for use in a postsurgical socket, in which a custom made ocular prosthesis is indicated. The method is particularly suitable in the growing child where the prosthetics needs to be regularly modified to suitably fit the growing orbit.

Precautions are: It may cause initial irritation to the conjunctivae if an ethyl alcohol in the liquid is not thoroughly incorporated into the polyethyl methacrylate powder. If mixed in thick consistency and added excessively to the prosthesis, it may produce a protruded or exophthalmic ocular prosthesis. The tissue conditioner material may adhere to an exposed ocular implant made of acrylic resin or hydroxyapatite material, if a soft tissue dehiscence is present over the implant.[30]

Placement of the Custom Ocular Prosthesis

The custom ocular prosthesis can then be placed. The patient should return after 1 day, 3 days, and 1week for follow up. Once a week the prosthesis should be removed by the patient and cleaned with mild soap and rinsed well. The prosthesis should be inspected for scratches or deposition. If any are noted, the patient should return to have the prosthesis repolished.

The patient should return at about 6-month intervals to have the defect and prosthesis evaluated and adjusted as necessary.



Completed custom ocular prosthesis

Chambers, Lemon, and Martin describe an anterior key method for indexing orbital prostheses. Most procedures involve registration of the ocular on an index anchored to the posterior surface of the defect on the stone master cast. Indexing the ocular from the posterior cast surface is precarious and may displace the ocular form its index. They say that the alternative approach, i.e, indexing from the anterior, provides a solid backing without modification of the cast or multiple stone pours. Autorotation, retention, and accuracy are the three benefits of this technique.[113]

Mekayarajjananoth et al describes a mold for making procedure for multiple orbital prostheses fabrication. The technique presented offers an improvement that provides a mold acceptable for fabricating multiple orbital prostheses by use of light polymerizing material surrounding the palpebral part of the orbital mold, which is commonly made of improved stone.
Procedure:

1.Make an impression of the orbital defect and fabricate a master cast with improved dental stone.
2.Prepare vertical and horizontal grooves into the posterior surface of the ocular prosthesis for keying it to a pedestal base after wax / clay elimination.
3.Adapt tin foil to the defect on the master cast and complete the sculpture of the prosthesis with oil-based clay. Verify the prosthesis on the patient for adaptation, marginal fit, and appearance.
4.Prepare a channel approximately 7 to 10 mm in diameter from the back of the master cast, which approximates closely to the reverse of the ocular prosthetic surface once the sculpting has been completed.
5.Identify the approximate outline of the contained ocular prosthesis on the underside of the clay sculpting by visualizing the tin foil placed in step 3. Carefully cut the tinfoil with a blade, taking care not to distort the sculpture. Make an outline of a small circle in the clay and enlarge to expose the underside of the ocular prosthesis and keyed surface. Do not excavate clay/

foil past the peripheral margins of the ocular prosthesis. Lubricate this surface lightly with a petrolatum gel.

6.Secure the sculpting of the prosthesis to the master cast by finishing the margins with extra clay.

7.Pour improved dental stone into the prepared channel on the backside of the cast, taking frigate care not to distort the sculpture or to let the freshly poured stone drip out of the channel.

8.Add two 3-mm autopolymerizing acrylic resin pair nodules on the surface of the ocular prosthesis corresponding to the medial and lateral limits of the iris. After setting has occurred, coat the area lightly with petrolatum gel. These ensure the ocular and opposing molds are correctly aligned when silicone is place into the mold.

9.Apply clear, unfilled light-polymerizing resin gel to cover the ocular and delicate fissuring on the sides of the canthus. Before light polymerizing, add stainless steel wire bent into the gel projecting irregularly 1 to 2 cm out of the light-polymerizing resin gel to provide a mechanical lock from the gel to the dental stone.

10.Coat the exposed stone surfaces of intaglio surface of the cast with a petrolatum gel before pouring the opposing part of the mold with improved dental stone.

11.After the upper half of the mold has set, separate the halves and eliminate the clay sculpting material by gross removal and a mild detergent scrub.

12.Thoroughly clean the ocular prosthesis with mild detergent and water. Insert and invest in a split gypsum mold to duplicate it in auto polymerizing acrylic resin. This will serve as a blank for producing duplicate silicone prosthesis without the need for the patients present prosthesis.

13.After both halves of the mold have been prepared for packing, place the ocular prosthesis nodule side down onto the resin gel pat of the opposing mold half. Make sure the tissue half of the mold closes correctly and completely.

14.After silicone packing and vulcanization, recover the prosthesis from the mold and trim all excess at the margins and palpebral fissure. Clean the prosthesis surface gently with acetone to remove any surface contaminants

placed by skin oils or mold separating media. Extrinsically tint the prosthesis in the usual manner.[43]

Jooste describes a method for fabricating a split mold to make multiple orbital prostheses with anatomical undercuts. The finish line is placed on the outer border of the eyelids, which allows or trial closure and esthetic characterization of the prosthesis.

Technique

1.Make facial impression using irreversible hydrocolloid with plaster reinforcement. Pour a cast in improved stone.
2.Make an RTV silicone mold of the stone cast. Cast the upper half of the orbital regions in die stone. When set, remove the stone and trim a surface perpendicular to the facial plane. Paint a separating medium over the trimmed surface. Replace the cast in the RT mold and cast the remaining half in die stone.
3.Remove, shape and taper the cast on a model trimmer to enclose the orbital part of the cast with a taper towards the base. Paint the tapered orbital part of the cast with a separating medium and fill the void with an improved stone.
4.After the stone is removed from the mold, use a large burr to cut a tapering hole through the base of the ocular part of the cast. The taper follows the same direction as the taper of the orbital part of the cast.
5.Position the ocular part of the prosthesis and sculpt the external surface of the orbital part to verify fit, appearance, and marginal extension. Remove the wax from the posterior surface of the ocular part of the prosthesis.
6.Syringe a ring of silicone impression material around the periphery of the ocular part of the prosthesis and hold it in position on the cast until the material has set. Remove the silicone ring and ocular part of the prosthesis. Remove the ocular section and attach the silicone ring to the wax with cyanoacrylate glue. Paint a separating medium over all surfaces of the orbital cast.

7.Reposition the wax on the cast. Seal the margins with a hot instrument and invest it in the bottom half of a flask. Fill the interior cavity of the orbital prosthesis to the outer edge of the eyelids with die stone mixed under vacuum to exclude bubbles. Pour the top half of the flask in improved stone and boil out the wax.

8.Trial close, characterize, and process the prosthesis with a suitable flexible material. After processing, separate the mold in sections without destroying the mold or the prosthesis.

This technique is not presented to replace methods of mold construction. However, where there are tissue undercuts to be utilized and where characterizations for esthetic reasons is important, it is an alternative method that permits trial closure for multiple prosthesis.[109]

Complications of prosthetic treatment

The possibility of tumor breakdown and prosthesis or adhesive irritation presents a major concern for the prostodontist. However, other anatomic and physiologic areas are equally important. Inadeqate periorbital port may complicate the fit and appearance foam ocular prosthesis. If sufficient exophthalmic support is lacking, consideration should be given to either an implant or to an overlay orbital prosthesis.

When a sound margin can be obtained form the skin graft and the borders of the defect, the use of anatomic tissue undercuts can enhance prosthesis retention hollow prosthesis can be fitted that requires minimal or no medical adhesive for retention. However, if the tissue undercuts are engaged too aggressively, irritation from insertion and removal will result. Tissue sensitivity and fragility caused by medical adhesives also complicate daily use of the orbital prosthesis. When use of an adhesive complicates prosthesis wear, eyeglasses and implants have been used as sources of retention.[107]

CHAPTER 20: NASAL PROSTHESIS

By Dr. Amar Kumar

Large nasal septal defects can be indirectly obturated by the use of heat-processed acrylic resin intranasal stent. The medial wall of the stent will allow for partition of the two nasal cavities and the patency of stent wall allows for comfortable breathing. Construction of conventional heat-processed nasal septal obturators is limited to small defects that occur in the anterior septum. Mechanical closure of the nasal septal defect by artificial means has proved to be a safer and more predictable approach than surgical treatment.

Kern et al used a piece of paper in one nasal cavity and outlined the margins of the perforation in the other cavity wit a cotton ball dipped in thimerosal. This template was used to hand carve a nasal button from medical grade silastic silicone rubber.

Constructing the nasal septal obturator from an actual impression of the defect has proved to be the most logical approach in managing these defects. Nasal septal obturators are constructed of either medical grade silastic silicone rubber or heat-processed acrylic resin. Silastic silicone rubber cannot be highly polished and it is porous and friable. These inherent problems of silicone may lea to sorption of fluids, irritation of tissues form adhesion of mucus crust, and tearing of the material. In contrast, heat-processed acrylic resin can be highly polished, has fewer tendencies for water sorption, and mucus crust seldom adheres to its highly polished surface. The main disadvantage of constructing nasal septal obturators from heat-processed acrylic resin is its lack of flexibility. For septal defects that are larger than the stretched nostril insertion of the rigid heat processed acrylic resin obturator is often impossible and construction of a rigid acrylic resin nasal septal obturator is precluded.[114]

Young used hollow heat-processed intranasal inserts. These inserts were constructed by the use of low heat modeling plastic with an impression

wax surface. Each impression covered an area of approximately 2-cm into each nostril. The impression was invested and processed in clear polymethyl methacrylate. The final acrylic resin block was hollowed out to provide a patent nasal airway. The internal surface of the stent was highly polished to reduce mucus adhesion to the surface.[115]

Seals et al reviewed the indications, impression techniques, and laboratory procedures for different clinical situations that required intransal prosthesis, splints, and stents. They concluded that, although they presented techniques for managing common clinical problems, a unique clinical situation might arise.[116]

Heat processed acrylic resin conformers were used to maintain structural support of facial tissue that was injured from trauma or altered by surgical treatment. Holt and Parel fabricated a two-piece conformer joined together in situ by Velcro interlocking inserts to prosthetically replace the lost nasal septum.[114]

Alar stents made of clear heat polymerized acrylic resin have been used for the treatment of alar collapse and were reportedly well tolerated. Internal nares inserts were fabricated with heat-polymerized acrylic resin to restore support for the lateral nasal tissues and allow free passage of air through the nasal cavities. Tissue acceptance of the prosthesis was excellent. Breathing was restored within the health and function of the surrounding tissues. The external prosthesis junction was established at the mucocutaneous junction from a cosmetic standpoint, because there is no bridge connecting the two sides of the prosthesis.[41]

A number of biomaterials and techniques have been used in the fabrication of nasal prosthesis. Each material has advantages and shortcomings. Silicones are generally the preferred materials for fabrication because of lightweight and life-like appearance. However, silicone materials fall short of an ideal maxillofacial prosthetic material as adhesives do not

work well with silicones, and silicones are difficult to polish, have low tear resistance and have microbial growth promoting characteristics.[117]

Methods of overcoming these weak properties and taking advantage of the support features of the silicone materials have been introduced. For example, the process of using a prefabricated urethane sheet as a lining for the tissue surface of the silicone materials has been evaluated. The urethane sheet has a high tear resistance and is clear, smooth, easily cleanable, and compatible with many available adhesives. In addition, the urethane material can be satisfactorily bonded to metals and silicone materials, producing a superior prosthesis. Such prosthesis could be called a "composite prosthesis". [118]

Methyl methacrylate resin has been used as a maxillofacial material because it is easy to work with, hygienic, colored to match individual skin tone. However, its use is limited by its rigidity. Although attempts have been made to greatly improve the properties of various maxillofacial materials, there is still no ideal material that resembles or duplicates human skin. An effective, noninvasive method for prosthetic rehabilitation of a nasal defect is with a mechanical retention design using an eyeglass frame. The advantages of this prosthesis are that the technique is noninvasive, cost-effective, tissue tolerant, esthetic to the patient, comfortable to use, and easy to fabricate and clean.[117]

Technique

Impression of Nose Defect

The eyebrows and eyelashes are coated with Vaseline, the extreme undercuts are minimized with wet gauze packing, and the nostrils are packed to prevent adherence, seepage, and breakage of the impression materials during the removal.

Making Master Cast

Dental stone is prepared, and poured slowly on the hydrocolloid impression, and vibrated carefully to avoid bubble formation. When the stone has set, the

cast is trimmed as desired and all undesirable undercuts are blocked out with pink wax preparatory to clay modeling.

Carving of Clay Pattern

A preoperative photograph of the patient and the observation and assistance of close relative are very helpful in modeling the characterized nose.

Construction of Metallic Molds

External mold, an impression of the clay pattern is made with alginate material.

Pour investment in the alginate impression, separates the investment model, and trim to the indelible outline. The investment model is waxed with three thickness of pink baseplate wax, and the main sprue (green boxing wax) is added at the lowest point of the model. A V-shaped groove is carved 5 mm from the edge of the entire model outline. After investing the waxed model in a sheet metal ring with Gray investment, the investment ring in the boil-out pot for 20 minutes to eliminate wax.

Preparatory to casting the mold, linotype ingots are melted, and the cast is poured with molten linotype metal and a gas air torch. To prevent porosity in the metal mold, the main sprue is kept molten for about 5 minutes.

Tissue-side Mold, Double impression taken: Remove unwanted block-out wax in the undercut areas. Make an impression of the tissue side (defect side) with hydrocolloid material. The negative hydrocolloid impression is separated from the master cast and boxed in with softened green boxing wax. Make a positive alginate impression of the negative hydrocolloid impression. The gray investment is poured in the positive alginate impression.

Model is waxed with three thickness of pink baseplate wax. A V-shaped groove is carved 5 mm from the edge of the entire model outline.

Invest the waxed model in a sheet metal ring with Gray investment and place the investment ring in a boilout pot for 20 minutes to eliminate wax. Cast is poured with molten linotype metal. Separation and grinding in are done with the external mold for close approximation of the two molds.

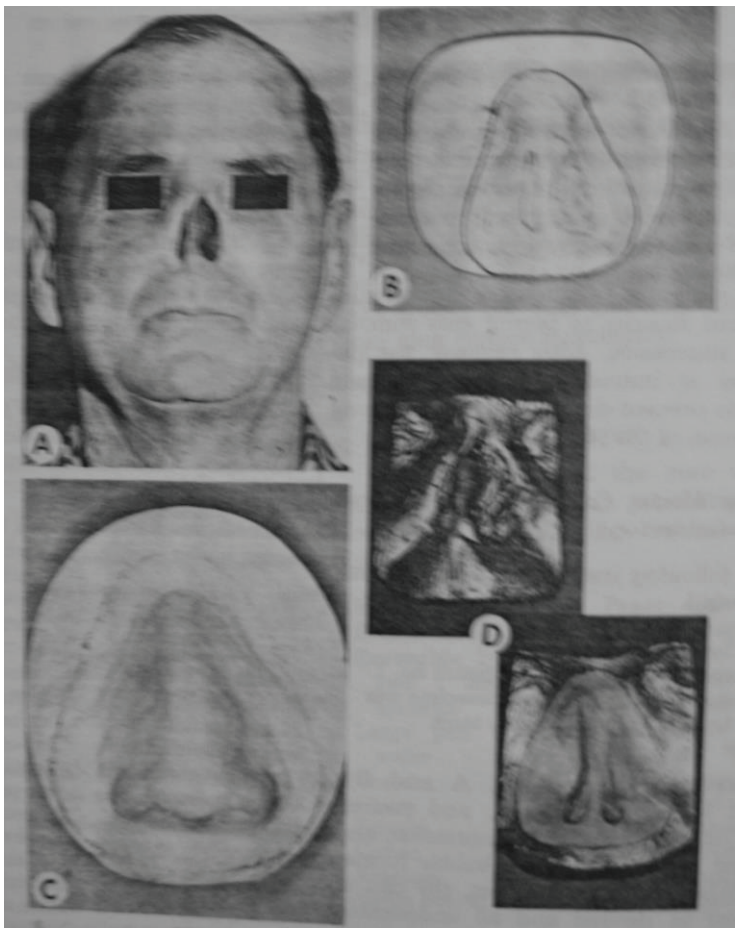
Painting and Processing of Vinyl Resin Paste

Painting of External Mold

A very thin layer of clear vinyl resin is painted on the surface of the mold, and the second thin layer of the vinyl resin is added with tissue-matched paste. Freckles and blood vessels may be added. Each layer of the paste is processed in the oven for 1 minute.

Painting of Tissue side Mold

Each layer of the paste is processed in the oven for 1 minute at 190^0 C. the two molds are then closed and clamped together.



A] Nasal defect

B] Cast showing defect

C] Clay pattern of nose seated over master cast

D] Two metal molds showing nasal prosthesis

Final Processing

After the required processing time period, the molds are removed from the oven. The two molds are nose prosthesis is removed. Oil- soluble dye retouching the nose prosthesis is tinted to the desired color, and characterization is added with xylene soluble oil dyes.

Fitting of Artificial (Vinyl Resin) Nasal Prosthesis

The artificial nose is fitted to the patient’s defect.

CHAPTER 21: AURICULAR PROSTHESIS

By Dr. Kishore Kumar

There are several methods of sculpting an auricular prosthesis. These include obtaining the reverse image of the ear of a family member or an individual with compatible ear morphology, making and using a mirror image cast of the patient's remaining ear, and more ideally obtaining a presurgical cast.[29]

In 1980, Nusinov and Gay described a method for obtaining the reverse image of an ear by using parallel lines transferred to casts, a vertical camera capable of reproducing three-dimensional objects, and tracing paper.[119]

Shimodaira et al proposed surperimposing a color side onto a facial cast to sculpt a facial prosthesis. Both methods are relatively complex and require special and costly equipment. However, making a transparency copy of the contralateral anatomic part and placing it in reverse over the working cast to assist in the sculpting can overcome these problems.[120]

Lemon et al describes a technique for fabricating a mirror – image prosthetic ear.

Procedure:

Make an impression of the contralateral ear and prepare a cast. Position the cast on the copying machine andorient the helical plane as parallel as possible to the glass.

Copy this on a blank transparency. Cut the transparency to approiate size and fix it to a rigid frame. Superimpose the transparency over the sculpting to aid in shaping and forming it. Complete the sculpting in usual fashion.[29]

Ear prosthesis fabrication

Making Impression

Impression of the defective side and the natural ear is made by painting on reversible hydrocolloid (ratio: 50% hydrocolloid, 50% water). Prebent L-shaped paper lips are used for reinforcement, and quick setting plaster of Paris is added for backing.

Making Stone Casts

Pour the stone into the hydrocolloid and alginate impressions. The stone casts are trimmed and shaped to the desired form and the undercuts are blocked.

Carving of Clay Pattern

Tin foil is molded on the defective ear area of the master cast, and small strips of modeling clay are added one upon the other until the height and contour of the helix match those of the natural ear. The clay pattern of the ear is now tried on the patient's defect. The proper placement, positioning, and any esthetic corrections should be completed at this time.

Construction of Metallic Molds

Key the master cast in a V shape in three areas: two on the anterior and one on the posterior edge. Make an alginate impression of the posterior section. Prebent L-shaped paper clips are used for reinforcement, and quick setting plaster of Paris is added for backing. The alginate impressions are keyed in a V shape in two areas.
Then pour with Gray investment, and the impression are separated from the Gray models and trimmed to the outlined area.

Tissue-side Mold; Double Impression:

Make a negative hydrocolloid impression of the defect paint the negative hydrocolloid impression with a film of glycerin as a separator. Make the positive alginate impression. The positive alginate impression is then poured in Gray investment, and the Gray model is separated.

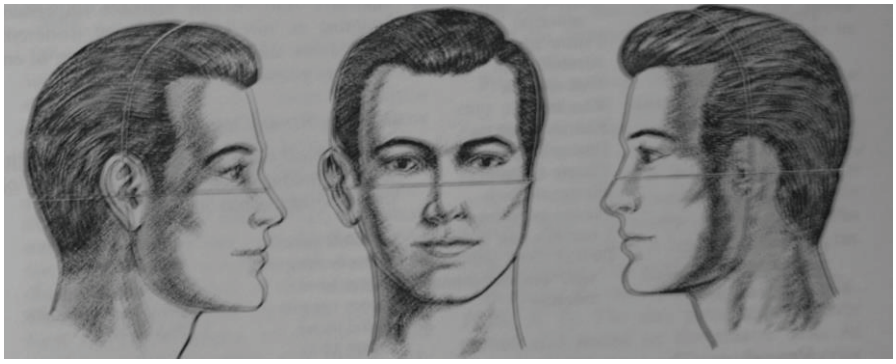
Gray investment models are waxed with three thickness of baseplate wax. Main spurs, ½ by ¾ inch, are added at the lowest edge of the models. A V shaped groove is carved 5 mm from the edge of the entire outline of each waxed-up model. Gray investment models are invested in separate rings. The rings are placed in a boilout pot for 20 minutes to eliminate the wax. Pour the casts with the metal.

Painting of external Mold: Thin layer of the vinyl resin is added with tissue-matched paste. Freckles and blood vessels are added with the different pigments of vinyl resin.

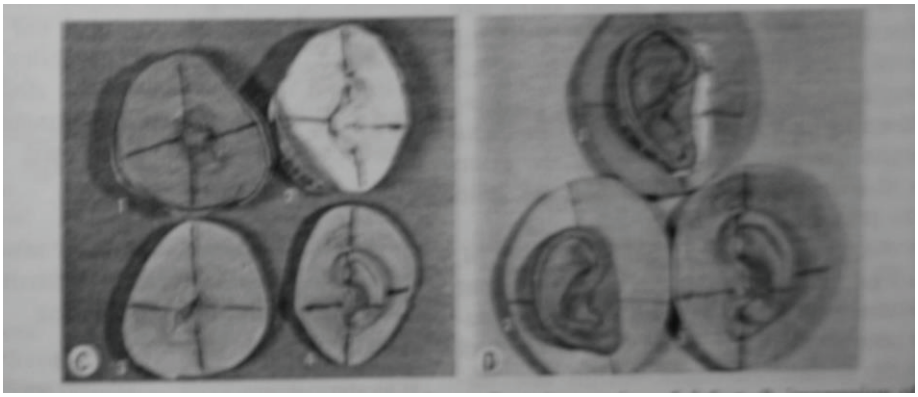
Painting of tissue side mold: Continue to paint with the paste until the desired thickness is obtained. Before closing the sections of the mold paint the margins with fresh paste as a seal.

After the required processing time period, remove the ear prosthesis and trim the edges with curved scissors and a cherry stone.

Oil-soluble Dye Retouching: The ear prosthesis tinted to the desired color, and characterization is added with xylene soluble oil dyes.

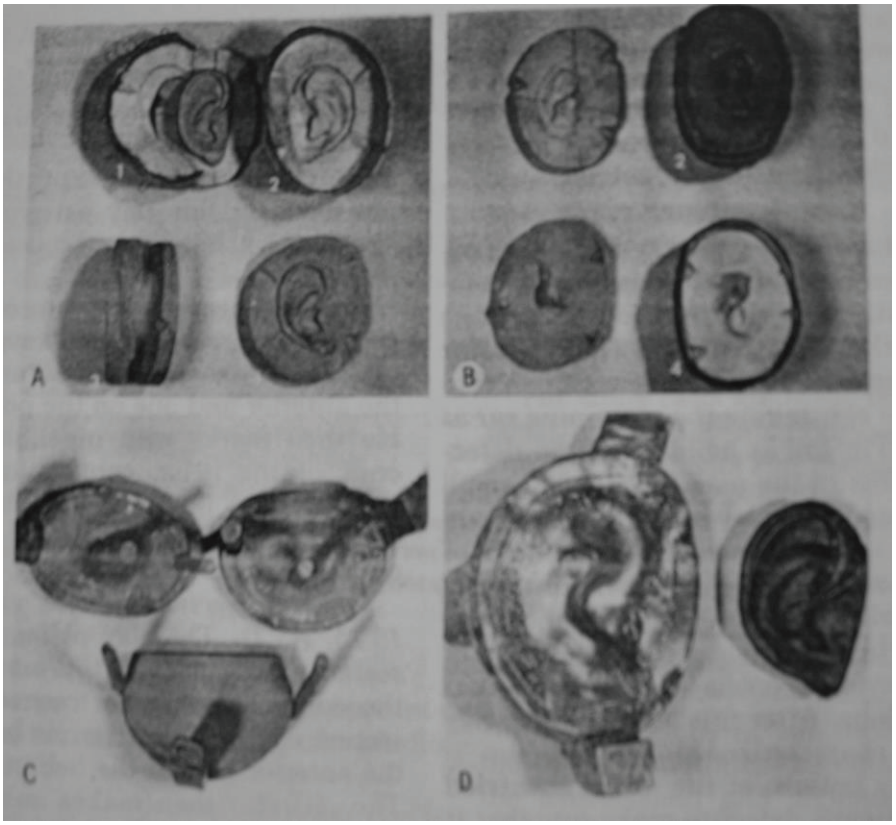


Orientation lines for positioning of auricular prosthesis



C: 1 Impression of the defect
2 impression of opposite ear
3 stone cast of defect
4 stone cast of opposite ear

D: 1 clay added on defective ear
2 right ear molded in clay
3 stone cast of left natural ear



A: 1 alginate impression, posterior section
2 overall impression
3 posterior gray investment
4 anterior gray investment

B: 1 master cast
2 negative impression
3 refractory cast
4 positive impression

C: three gray investment models

D: closed mold with prosthesis

Russell Wang describes a procedure for fabricating a surgical template from a diagnostic wax up of an ear without destroying the wax pattern. A full contour template can assist in proper positioning of craniofacial implants, which in turn can complement the prosthetic result.[122]

Procedure

1.Make moulage impressions of both the unaffected auricle and the tissue base of the missing auricle using either an irreversible hydrocolloid or an elastomeric impression material. Pour the impression with dental stone and properly the trim in the case.
2.Sculpt a diagnostic wax- up of the ear prosthesis on the working cast to create to create a minor image of the opposite ear. Try the wax ear prosthesis on the patient and modify the size, shaper, and orientation of the wax ear.
3.Create indexes on the wax contour of the ear to easily identify its orientation in relation to the patient's anatomic landmarks, namely, auditory canal, posterior, superior, and borders of the remaining tragus (if present).
4.Use 3 to 4 utility wax strips (1.5 inches in length) as sprues. Place the sprues at the highest and lowest areas of the wax ear. The sprued wax ear should be stabilized with a small piece of utility wax in a denture cup such that the anterior border of the ear and the helix are at the same horizontal level.
5.Mix irreversible hydrocolloid impression material in a vacuum mixer with water to powder 1: 1 ratio by volume and pour the impression material to fill the denture cup just to the level of the anterior border of the wax ear lobe, concha, and antihelix. Wait until for the irreversible hydrocolloid to set and use a knife to create 3 triangle indexes on the alginate surface.
6.Inject light body addition silicone impression material onto the wax ear to cover the entire wax ear. If the light body impression material tends to slump from the higher areas, such as helix and antihelix, to the lower areas (triangle fossa and concha areas, then a thin layer of regular addition silicone impression material can be added on top of the light body impression material so that the entire wax ear can be covered evenly by the impression materials.

7.Paint liquid impression tray adhesive on the addition silicone material, and pour alginate material to fill the denture cup. After the irreversible hydrocolloid impression material has set, retrieve and remove the wax ear and sprues from the denture cup by separating the upper and lower parts of the mold.
8.Reorient the upper and lower parts of the impression material molds by matching the indexes. Put both parts back into the plastic denture cup.
9.Mix autopolymerizing resin powder and liquid in a 1:1 ratio and pour the acrylic resin into a 5cc plastic syringe. When the acrylic results is in a low viscous state, inject the material into the sprues until acrylic resin fills the mold spaces. (The acrylic resin should be injected into the sprue where it is attached to the highest level of the wax ear to ensure all the spaces are filled without any voids). Retrieve the acrylic resin ear after the material has completely polymerized. Trim away the excess material and sprues.
10.Use no 6 acrylic resin bur to make a trough groove from the 11 o' clock to 7 o' clock position along the antihelix area for the right ear template and from the 1 o' clock to 5 o' clock position for the left ear template.
11.Properly finish and polish the acrylic resin ear. Soak the template in a disinfectant before sending to the operating room for the surgical implant placement procedure.

This duplication method preserves the diagnostic wax ear that can be modified later for the final contour and ear mold fabrication. Clay material is not recommended for diagnostic ear sculpting become it lacks rigidity and likely be destroyed during the duplication procedure when retrieving the ear from impression mold.

The advantages of this method are the accurate duplication of a diagnostic wax ear for the surgical plate fabrication and the sculpting procedure for final ear prosthesis is shortened. The method also uses 2 piece molds rather than 3 piece molds for template fabrication. The disadvantages of the techniques are that it is time-consuming and it is costly.[122]

Use of CAD-CAM

Design and fabrication of auricular prostheses by CAD/CAM are advantages, since a highly skilled technician is not required to sculpt a wax ear. The whole process is undertaken solely on the computer and the patient can see the result on the screen before the patient can see the result on the screen before the ear is fabricated. Much faster than the traditional process the digital image and silicone mold can be preserved. The latter is durable and permits multiple pouring. This is important, since a replacement is usually required every 2 years because of discoloration of the pigments in silicone elastomer.[46]

Use of implants

Tjellstrom first reported the application of craniofacial implants for facial disfigurement.[119]

The use of craniofacial implants for retention of extraoral prostheses, such as ears, offers excellent support and retentive abilities and improves a patient's appearance and quality of life. They can eliminate or minimize the need for adhesive and allow proper orientation and seating of ear prosthesis. However, a satisfactory outcome may only be achieved by careful planning in terms of the number and position and orientation of the implants and the proper connection of the ear prosthesis to implant retention structure with a cast or machined bar. Precious alloys are commonly used for construction of a bar because of their excellent strength, but casting precious alloys onto wrought metals may not result in a perfect union.

Chung et al said that use of magnets is advantageous over conventional bar and clips for maintenance because metal clips may fracture over time making revision and repair difficult. Although keepers can be placed directly over the abutments of implants for the magnet-retained ear prosthesis, the use of a bar provides an increased area for placement of larger magnets/ keepers, and the use of an increased number of magnets/ keepers. The thickness of the bar it self also provides additional support for the ear prosthesis against gravitational and lateral dislodgment forces.[121]

The prosthetic involvement in providing a patient with an implant-retained auricular prosthesis can be considered in 2 stages: presurgical and postsurgical phases.[123]

Prosthetic involvement for implant retained ear prosthesis:

(A) Presurgical phase

Examination and consultation

Diagnostic cast fabrication

Diagnostic waxup, clinical modification, and confirmation

Surgical template fabrication and determination of craniofacial

Implant location, 20 mm away from the external ear canal at 8 and 11 o' clock positions on the right side and 1 and 4 o' clock positions on the left side of the ear

(B) Postsurgical phase

Implant connection

Impression making

Fabrication of working cast

Design and fabrication of framework, a bal/stud attachment, a Magnetic retention, or a bar/clip system can be used for orientation of the prosthesis

Sculpting the ear and modification

Three-piece stone mold fabrication for silicone casting

Intrinsic coloring and establishing an intrinsic formula

Casting of silicone ear prosthesis

Extrinsic coloring

Care of the prosthesis and tissue around the implant abutments

Regular follow-up

A long-term follow-up result of craniofacial titanium implants in the adult subjects without irradiation has been favorable. Children from ages 5 to 12 are considered at a higher risk for complications because of thinner and softer temporal bones and are at an increased risk for a disruptive accident injury. Tjellstrom reported that during placement of implants for hearing aids, 12%

were in contact with the dura mater, the wall of the sigmoid sinus was seen at the bottom of the implant site in another 12% and mastoid air cells were seen in 25%. Children with severe craniofacial defects pose special problems relative to the implant site because of aberrant facial nerve course, low middle cranial fossa dura, and small mastoid. Long term stability of implants may be further compromised at puberty when the mastoid air cells undergo their greatest development.

The psychologic impact of early placement of implants is another important issue. Studies of psychological and social effects on adults with facial deformities reported that all the patients went through periods of emotional turmoil related to their appearance, and all experienced periods of marked depression that impaired emotional and social functioning. Psychologic problems in children with craniofacial deformities have included lack of emotional attachment between parents and child, inadequate development of peer relationship and the experience of shame related to a poor body image.[123]

CHAPTER 22: REHABILITATION OF MID FACIAL DEFECTS

By Dr. Amar Kumar

Patients present with facial defects that are result of congential anomalies, trauma, resection of cancer, or some combination of these occurrences. Surgical reconstructive methods are constrained by the integrity and availability of local and remote tissue beds, the patient's ability to withstand such procedures, the difference in tissue colors and textures that become obvious after surgical procedures, and the requirements of viewing a site that has undergone surgery because of cancer. Prosthodontic reconstruction is constrained by the patient's ability to accept something that is not natural and is removable, the resulting tissue bed that holds the prosthesis (i.e., mobile tissue that emphasizes lines of demarcation of a prosthesis), the retention of a prosthesis, and the materials currently available.[52]

Prosthetic reconstruction is indicated with larger defects if they involve cancer and some sort of adjunctive therapy that require some time to evaluate for recurrence. Decreased vascularity and fibrotic tissue at the defect periphery that result from radiation treatment may preclude surgical rehabilitation completely.

Age is another factor. Older patients are more likely to receive restoration via prosthetic means.

Midfacial defects are defined as those confined to the middle third of the face in the horizontal plane and that communicate with intraoral maxillary defects. Difficulty in speech, deglutition, control of saliva, and mastication may accompany the usual facial disfigurement.

Classification

Midfacial defects can be classified into the two major categories of midline and lateral. Midline midfacial defects include complete or partial involvement of the nose and / or upper lip, and communication with an

intraoral maxillary defect. Lateral midifacial defects include complete or partial involvement of the cheek and orbital contents, and communication with an intraoral maxillary defect.

Combinations of the two major categories are usually larger and more complicated to restore. These defects are created by trauma or by surgical resection of malignant neoplastic disease in the region.[124]

Intraoral considerations

Include the extent and nature of the remaining maxilla, the presence or absence of periodontally sound teeth in both arches, the status of the tongue, and the function of the mandibular arch and lower lip.

Unfavourable access to the nasal floor is usually the result of a reconstructed upper lip fragment. These frequently become scarred, which presents a barrier to the placement of the intraoral prosthesis or prevents appropriate extensions to surface – bearing areas that could facilitate retention and stability. Enlarged or displaced turbinates may also preclude access to regions that would improve retention. The lack of lateral or posterior undercuts in the nasal cavity or antral walls of the defect greatly reduces the potential for intra defect mechanical retention. When present, these retentive tissues should be surfaced with a keratinized epithelial surface if they are to be useful in prosthesis retention. This is best accomplished as the time of tumor resection with the use of split – thickness skin grafts.

If a significant amount of the anteroposterior maxilla is resected, support must be gained from the more superior aspect of the defect. In larger defects, prevention of superior displacement can be accomplished by engaging the facial portion with the superior aspect of the defect. Magnets or other retentive devices can also be used to stabilize these prostheses.

With extensive or complete loss of the maxilla, support and retention may include:

1.Engaging available soft and hard tissue undercuts with a resilient silicone liner.

2.Engaging inaccessible undercuts in the lateral antral walls with passive coiled springs attached to the intraoral portion

3.Two –piece restoration.

Extraoral considerations

Extraoral factors to consider are the status of upper and lower lips, margin location of the defect, mobility of supporting tissue beds, available undercuts, nature of supporting tissue, amount of scar contracture, and surgical aids.

> The mobility and function of the lower lip is rarely impaired. When it is, prosthetic rehabilitation is difficult. The lower lip is an important speech articulator and normal function is required to maintain oral competency. Although the lower lip can be restored prosthetically, speech will never be normal and the patient will constantly lose saliva from the corners of the mouth.

Reconstruction of the upper lip is often ill advised. The reconstructed upper lip is stiff and immobile and generally displaced posterior-superiorly. Although it may provide retention for the extraoral portion of the prosthesis, it does so at the risk of reducing the oral opening to unfavourable levels.

Difficulties with speech articulation can be encountered especially when such an upper lip is in an abnormal position.

The proprioceptive input of an intact functioning lower lip can aid in balancing and stabilizing a large midfacial prosthesis. The presence of undercuts within the nasal cavity lateral margins of the defect, and orbital fossa will aid in retention.

Excessive scar contracture can distort structures adjacent to the defect, limiting the final esthetic result. Split – thickness skin graft will reduce scar contracture, limit tissue mobility at the margins and provide improved tissue surface qualities for prosthesis support. These grafts will prevent raw tissue surfaces created at tumor resection from epithelialising with respiratory epithelium or nonkeratinizing squamous cell epithelium. The respiratory epithelium of the nasal cavity and paranasal sinuses is sensitive and less tolerant to the contact forces generated by a prosthesis.

Clinical procedures

Fabrication

The sequence of fabrication includes a surgical, a provisional and a definitive prosthesis. The surgical prosthesis will provide support for skin grafts at the time of surgery. Provisional combination oral and extroral prostheses can be constructed and delivered 2 to 3 weeks after surgery. Presurgical records (photographs, vertical dimension, and impressions) will facilitate the fabrication of prostheses. Tissue adaptation modification can be accomplished with denture tissue–conditioning materials. The prostheses allow the patient to swallow, facilitate salivary control, improve speech articulation, and can provide acceptable appearance.

Fabrication of definitive prostheses can be started when adequate healing has taken place. With adequate block-out of undercuts and protection of the airway, a preliminary impression in irreversible hydrocolloid is obtained. An increased liquid-to-powder ratio is used, which results in a less viscous, free flowing material.

Before the material gels, modified paper clips or cotton gauze pads are carefully placed onto the surface of the impression. This will provide retention of the stome that will be poured over the impression. To maintain the dimensional integrity of the impression during removal and casting in stone, a quick – set stone template is poured over the prepared impression surface. When the stone has set, the impression is removed and cast in stone. A tray is fabricated from the resulting cast.

After the tray is border molded, the impression is completed with an elastic impression material. Care should be taken to maintain the patient in an upright position to avoid distortions due to postural changes.

Record bases are constructed from the master cast, and the vertical dimension of occlusion is recorded. Problems encountered with establishing vertical dimension include the absence of an upper lip, unstable record bases, and impaired motor and proprioceptive patterns. Speech articulation and swallowing are usually the most helpful guides in determining vertical dimension for these patients. Therefore, the record bases must include a simulated waxed upper lip to enable the patient to effect speech articulation and provide a seal for swallowing. The shape and contour of the upper lip is developed by means of a functional impression against the lower lip. A scaffold of pink baseplate wax is developed to the approximate dimensions but is left short of the contacting lower lip. Impression wax is then applied to the inferior portion of the waxed prosthetic lip. To ensure a seal between prosthesis and lower lip, the patient is instructed to speak, swallow, and develop various facial expressions.

The functional height and shape of the prosthetic palate may need to be developed prior to vertical dimension determination or arrangement of anterior teeth. This is accomplished by developing the palate to its approximate counters in acrylic resin. Functional wax is applied to the palatal surface, and the patient is instructed to carry out the tongue movements involved in speech and deglutition. Sound production of /s/, /sh/, /t/, /d/, /n/, /ch/, /k/, and /ko/ is recommended for the development of palatal contours.

The maxillary anterior teeth are positioned by reestablishing the contour and position of the upper lip in wax. To enhance the stability of the complex prosthesis and minimize movement during function, the use of flat plane posterior teeth is suggested.

Processing

Processing is completed in the usual way. To reduce weight, the prostheses should be hollow. To limit tooth movement during processing, in the anterior region where a prosthetic lip is involved, the teeth should be luted together and in position with autopolymerizing acrylic resin prior to heat processing. To ensure complete processing, reduce voids, and the presence of free monomer, lowering curing temperatures (145° to 150°F) and longer curing times (18 to 20 hours) are in order.

Material

Choice of materials may be influenced by the following factors: need to engage undercuts, excessive tissue bed mobility, size of the facial defect, and weight of the prosthesis. When these factors are dominant, the patient will best be served by making the facial portion of the prosthesis of a lighter, more resilient material than acrylic resin. This approach will require a two – piece prosthesis with the intraoral portion in acrylic resin. Problems that may be encountered with the two-piece prosthesis are: 1.food impaction in and around the interface, 2.patient difficulty with control and manipulation.

Delivery

The prosthesis is delivered. Adjustments are necessary to accommodate the mobility of the prosthesis during function. Retention of the facial portion is accomplished by straps, adhesives, tape, eyeglass frames, eyepatch, engaging usable undercuts, teeth or a combination of these methods. When the capillary action of saliva and percolation of fluids at any of the peripheries is a problem, retention other than adhesives must be used because these fluids will render the adhesive ineffective.[124]

According to Rouse and Chalian hollow extra oral prostheses have advantages and disadvantages. Although the increased weight of a hollow prosthesis may compromise its usefulness, the additional weight is distributed over the entire defect. In addition, the flexibility of the margins of a hollow prosthesis is reduced because the conformer is attached close to

the margins. The hollow prosthesis technique is also time consuming and involves at least one additional appointment for the patient.

Positively, the hollow facial prosthesis enhances retention by engaging anatomic undercuts. The conformer aids in orienting the prosthesis, which can be especially difficult for patients with large orbital defects. Adhesive can be eliminated, which can increase the life of thin margins. If adhesives are required to ensure retention, the increased surface area of the conformer provides additional contact areas. The convex surface of the conformer is not only easier to clean and maintain but the defect also tends to remain cleaner and free of secretions. The intimate contact between the prosthesis and the defect inhibits accumulation of debris within the defect for better hygiene.[125]

CHAPTER 23: CONCLUSION

By Dr. Desh Deepak

Patients with intraoral or extraoral defects will seek treatment to address the loss of comfort, function, or natural appearance. It is the Maxillofacial Prosthodontist's responsibility to provide prostheses that do not injure the remaining structures. As anatomy is altered, demands placed on residual structure increase. Endosseous implants can be used to provide retention, support, and stability for maxillofacial prostheses when the anatomy is no longer capable of fulfilling this function.

Prosthodontic rehabilitation of any maxillofacial defect is a lengthy and involved process. However, if attention is paid to the proper sequencing and details of treatment, it can be one of the satisfying procedures in all the branches of prosthodontics.

The science and art employed in the profession of dentistry can play an important role in the fabrication of prosthesis. The prosthodontist who exercises his creative ability, analytical approach and fundamental principles of complete denture construction can aid in the rehabilitation of many patients.

A rewarding area of prosthodontics is the rehabilitation of patient with acquired or congenital defect.

REFERENCES

1.Thomas D Taylor, editor. Clinical maxillofacial prosthetics. Carol stream, Illinois: Quintessence Publishing Co; 2000.

2.John Beumer III,Thomas A Curtis, David N Fritell. Maxillofacial rehabilitation Prosthodontic and surgical considerations. St.Louis: C.V. Mosby; 1979.

3.ChalianVA, DraneJB, StandishSM. Maxillofacial prosthetics multidisciplinary practice. Baltimore: Williams and Wilkins;1972

4.Ring ME. Dentistry: an illustrated history. New York: Abradale press;1985.

5.Gregory R. Parr, L. Kirk Gardner. The evolution of the obturator framework design. J Prosthet Dent 2003;89:608-10.

6.Laney W R. Maxillofacial prosthetics: postgraduate dental handbook. Littleton, Mass: PSG publishing; 1979.

7.Robinson JE, Rubright WC. Use of guide plane for maintaining the residual fragment in partial or hemi mandibulectomy. J Prosthet Dent 1964;14:992-94.

8.Swoope CC. Prosthetic management of edentulous mandibles. J Prosthet Dent 1969;21:197-99.

9.Schaaf NG. Oral reconstruction for edentulous patients after partial mandibulectomies. J Prosthet Dent 1976;36:292-95.

10.Mohamed A. Aramany. Basic principles of obturator design for partially edentulous patients. Part I: classification, J Prosthet Dent 1978;40:554-7.

11.Desjardins RP. Occlusal considerations for the partial mandibulectomy patient. J Prosthet Dent 1979;41:308-10.

12.Vergo TJ Jr, Chapman RJ. Maximizing support for the maxillary defects. J Prosthet Dent 1981;45:179-82.

13. Robert E. McKinstry, Mohamed A Aramany, Quinter C.Beery, Frank Sansone. Speech considerations in prosthodontic rehabilitation of the glossectomy patient. J Prosthet Dent 1985;53:384-87.

14.Robert E. McKinstry, Mohamed A.Aramany. Prosthodontic considerations in the management of surgically compromised cleft palate patients. J Prosthet Dent 1985;53:827-31.

15.Roger M. Watson, Barry J. Gray. Assessing effective obturation. J Prosthet Dent 1985; 54:88-93.

16.Piyawat Phankosol, Jack W. Martin. Hollow obturator with removable lid. J Prosthet Dent 1985; 54:98-100.

17.Seluk L W. et al. Stability of ceramic pigments of maxillofacial applications. J Oral Rehabil 1987;14:309-13.

18. Boris Schwartzman, Angelo A.Caputo, John Beumer. Gravity induced stresses by an obturator design. J Prosthet Dent 1990;64:466-468.

19.Rebecca J.Leonard, Robert Gillis. Differential effects of speech prostheses in glossectomised patients. J Prosthet Dent 1990 ;64:701-8.

20.Glenn E.Minsley, Donald W.Warren and W.Michael Hairfield. The effect of cleft palate speech aid prostheses on the nasopharyngeal airway and breathing. J Prosthet Dent 1991;65:122-6.

21. J.Schmaman, L.Carr. A foam impression technique for maxillary defects. J Prosthet Dent 1992; 68:342-4.

22. Jacobson M, Tjellstrom A, Fine L. A retrospective study of osseointegrated skin penetrating titanium fixtures used for retaining facial prostheses. Int J Oral Maxillofac Implants 1992;7:523-6.

23. J.J.Gary and M. Donovan. Retention designs for bone anchored facial prostheses. J Prosthet Dent 1993;70:329-32.

24.Anita Wedel, Evtim Yontchev, Gunnar E. Carlsson, Richard Ow. Masticatory function in patients with congenital and acquired maxillofacial defects.J Prosthet Dent 1994;72:303-8.

25.Johnston WM et al. Translucency parameter of colorants for maxillofacial prostheses. Int J Prosthetics 1995;8:79-86.

26.Witt P D,Rozelle A A,Marsh JL. Do palatal lift prostheses stimulate velopharyngeal neuromuscular activity ? Cleft Palate Craniofac J 1995;32:469-72.

27. Hussain S.Zaki, Katalin J.Ketzan, Ivo P.Janecka. The use of modified earpiece face bow in the restoration of orbital defects. J Prosthet Dent 1995;74:553.

28.Benington I C, Lappin C, Linden GJ. The clinical success and periodontal evaluation of patients rehabilitated with light cured obturators. J Oral Rehabil 1996;23:135-9.

29. James C.Lemon, Mark S.Chambers, Peggy J.Wesley and Jack W.Martin. Technique for fabricating mirror image prosthetic ear. J Prosthet Dent 1996;75:292-3.

30.R.K.K. Ow and S. Amrith. Ocular prosthetics: Use of a tissue conditioner material to modify a stock ocular prosthesis. J Prosthet Dent 1997;78:218-22.

31.Russell R. Wang. Sectional prosthesis for total maxillectomy patients: A clinical report. J Prosthet Dent 1997;78:241-4.

32. Russel R.Wang. Refining hollow obturator base using light activated resin. J Prosthet Dent 1997;78:327-9.

33.Hussain S. Zaki and Eugene N.Myers. Prosthetic management of large nasal septal defects. J Prosthet Dent 1997;77:335-8.

34.Arcuri MR, La VelleWE, Fyler A. Effects of implant anchorage on mid face prostheses. J Prosthet Dent 1997;78:496-9.

35.Umino S. Masuda G. Ono S. Speech intelligibility following maxillectomy with and without a prosthesis: An analysis of 54 cases. J Oral Rehabil 1998;25:153-7.

36.Ansgar C.Cheng, Alvin G.Wee, David Morrison and Walter G Maxymiw. Hinged mandibular removable complete denture for post mandibulectomy patients. J Prosthet Dent 1999;82:103-6.

37.Taichimura T, Nohara K, Hara H. Effect of placement of a speech appliance on levator veli palatini muscle activity during blowing. Cleft Palate Craniofac J.1999;36:224-7

38.Haug S P et al. Colour stability and colorant effects on maxillofacial elastomer. PartI. Colourant effects on physical properties. J Prosthet Dent 1999;81:418-22

39.Esposito S J, Mitsumoto H, Shank S. M. Use of palatal lift and palatal augmentation prostheses to improve dysarthria in patients with amylotrophic lateral sclerosis: A case series. J Prosthet Dent 2000;83:90-4.

40.Leanne M.Sykes, Johan F Wolfaardt, Ashwin Sukha. Prosthodontic rehabilitation of a patient with total avulsion of the maxilla: A clinical report. J Prosthet Dent 2002;88:362-6.

41.Vidya Kamalaksh Shenoy, Pratheek Shetty, Bhaskar Alva. Pinhole nasal prosthesis: A clinical report. J Prosthet Dent 2002;88:359-61

42.Mark Penn, Yoav Grossmann, Arie Shifman. A preplanned surgical obturator prosthesis for alternative resection lines in the anterior region. J Prosthet Dent 2003; 90:510-3.

43.Trakol Mekayarajjananonth,Thomas J.Salinas,Mark S.Chambers,James C.Lemon. A mold making procedure orbital prosthesis fabrication. J Prosthet Dent 2003;90:97-100.

44. Mark Mrunik, Nicholas Tselios. The efficacy of palatal augmentation prostheses for speech and swallowing in patients undergoing glossectomy: A review of literature. J Prosthet Dent 2004;91:67-74

45. Barry H.Habib, Carl F.Driscoll. Fabrication of a closed hollow obturator. J Prosthet Dent 2004; 91:383-5.

46.Ting Jiao, Fuqiang Zhang, Xuemei Huang and Chengtao Wang. Design and fabrication of auricular prostheses by CAD-CAM system. Int J Prosthodont 2004;17:460-463.

47.Igal Savion and Michael L. Huband. A feeding obturator for a preterm baby with a Pierre Robin sequence. J Prosthet Dent 2005;93:197-200.

48.Glossary of Prosthodontic Terminology 1999.

49.Roberts A. C and Penney H.D.An advance in facial and body prosthesis material. Dent Pract 1964; 15: 7-13.

50.Lewis D H, Castleberry D J. An assesment of recent advances in external maxillofacial materials. J Prosthet Dent 1980; 43:426-9.

51.Gonzalez JB.Physical and mechanical behaviour of polyurethane elastomer formulations used for facial prostheses. J Prosthet Dent 1978; 39:307-18.

52.Heidi Huber, Stephan P. Studer. Materials and techniques in maxillofacial prosthodontic rehabilitation. Oral Maxillofacl Surg Clin N Am 2002;14:73-93.

53.Firtell D N. Light weight RTV silicone for maxillofacial prostheses. J Prosthet Dent 1976;36:554-57.

54.Chalian V J.Milling matching for coloring heat-vulcanising silicone materials in maxillofacial prosthetics. J Prosthet Dent 1974;40:78-80.

55.Moore DJ et al. evaluation of polymeric materials for maxillofacial prosthetics. J Prosthet Dent 1977;38:319-22.

56.Hulterstrom A K. Changes in appearance of silicone elastomers for maxillofacial prostheses as a result of aging. International J of Prosthetics 1999;12:498-504.

57.Mohite UH. Environmental factors affecting mechanical properties of facial prosthetic elastomer. International J of Prosthodont 1994;7:479-86.

58.Waters M G.Wettability of silicone rubber maxillofacial prosthetic materials.J Prosthet Dent1999;81:439-43.

59.Woolfaardt J F. Mechanical properties of a new facial prosthetic material. J Prosthet Dent 1985;53:228-30.

60.Haug SP. Effects of various environmental factors on maxillofacial elastomers. Part IV. Optical properties. J Prosthet Dent 1992;68:820-23.

61.Wolfaardt JF. Mechanical behaviour of three maxillofacial prosthetic adhesive systems: a pilot project. J Prosthet Dent1992;68:943-9.

62. John J. Gary, Charles T Smith. Pigments and their application in maxillofacial elastomers: A literature review. J Prosthet Dent 1998;80:204-8.

63.Lemon et al. Color stability of facial prostheses. J Prosthet Dent 1995;74:613-8.

64.Tamamata T et al. Evaluation of color changes of silicone materials after exposure to sunlight. Dent Mater J 1989;8:260-70

65.Parel S and Tjellstrom A. The United States and Swedish experience with osseo integration and facial prostheses. Int J Oral Maxillofac Implants 1991;6:75-78.

66.Wolfaardt J, Wilkes G, Parel S,Tjellstrom A. Craniofacial osseointegration: The Canadian experience. Int J Oral Maxillofac Implants1993;8:197-201.

67.Tolman D and Desjardins R. Extra oral application of osseointegrated implants. J Oral Maxillofac Surg 1991;49:33-7.

68.Holgers K, Tjellstrom A, Bjursten L, Erlandsson B. Soft tissue reactions around percutaneous implants. Int J Oral Maxillofac Implants 1987;2:35-8.

69.J.J. Gary, M.Donovan. Retention designs for bone anchored facial prostheses. J Prosthet Dent 1993;70:329-32.

70.Nishimura R, Roumanas e, Moy P, Sugai T. Nasal defects and osseointegrated implants: UCLA experience. J Prosthet Dent 1996;76:597-600.

71.Lundgren S, Moy P, Beumer J,Lewis S. Surgical considerations for endosseous implants in the craniofacial region:A 3-year report. Int J Oral Maxillofac Surg 1993;22:272-6

72.Keller E, Desjardins R, Eckert S, Tolman D. Composite bone grafts and titanium implants in mandibular discontinuity reconstruction. Int J Oral Maxillofac Implants 1988 ;3:261-4.

73.Brown K.Peripheral considerations in improving obturator retention. J Prostet Dent 1968;20:176-9.

74.Roumanas E, Nishimura R, Davis B, Beumer J. Clinical evaluation of implants retaining edentulous maxillary obturator prostheses. J Prosthet Dent 1997;77:184-8.

75.Gillis R. Psychological implications of patient care. In Laney W. Maxillofacial prosthetics. Littleton, MA: PSG Publishing Co,1979:Chapter 2.

76.J. Timothy Newton, Janice Fiske, Oliver Foote, Cooralie Frances, Iona M. Loh, David R. Radford. Preliminary study of loss of part of face and its prosthetic restoration. J Prosthet Dent 1999;82:585-90.

77.Flemming T. Oral tissue changes of radiation oncology and their management. Dent Clin North Am 1990;34:223-9.

78.Brown L, Dreizen S, Daly T.Interrelations of oral microorganisms, immunoglobulins, dental caries following radiotherapy. J Dent Res1987;57:882-6.

79.Marx R. A new concept in the treatment of osteoradionecrosis. J Oral Maxillofac Surg 1983;46:351-5.

80.King EM. Cast circumferential and wire clasps for obturator retention. J Prosthet Dent 1983;49:799-802.

81.Mac Entee M. Obturator-overdentures retained by non-rigid attachments. J Prosthet Dent 1979;41:189-92.

82.Wang R. Adhesion of silicone to polyurethane in maxillofacial prosthese. Int J Prosthodont 1994;7:43-9.

83.John D Walter. Obturators for cleft palate and other speech appliances. Dent Update 2005; 32: 217-23.

84.Debra S.Dorf, M. A, David J. Reisberg and Henry O. Gold. Early prosthetic management of cleft palate. Articulation development prosthesis: A preliminary report. J Prosthet Dent 1985; 53: 222-25.

85.Derek Moore and J. Fraser Mc Cord. Prosthetic dentistry and the unilateral cleft lip and palate patient. The last 30 years. A review of the prosthodontic literature in respect of treatment options. Eur.J.Prosthodont.Rest. Dent 2004;12:70-4.

86.Desjardins R. P. Obturator prosthesis design for aquired maxillary defects. J Prosthet Dent 1978;39:424-7.

87.Leubke R. J. Sectional impression tray for the patients with constricted oral opening. J Prosthet Dent1984;52:135-7.

88.Carl W.Preoperative and immediate postoperative obturators. J Prosthet Dent1976;36:298-305.

89.Hiroshi Murata, Taizo Hamada and Rapeephan Nagasiri. Stabilising record bases for edentulous obturator prostheses with silicone resilient relining material. J Prosthet Dent 1999; 82:366-8.

90.Ashok Jhanji, Steve T. Stevens. Fabrication of one piece hollow obturators.J Prosthet Dent1991;66:136-8.

91.Paprocki GJ, Jacob RF, Kramer DC. Seal integrity of hollow bulb obturators. Int J Prosthodont 1990;3:457-9.

92.L.Kirk Gardner, Gregory R. Parr and Arthur O. Rahn. Simplified technique for the fabrication of a hollow obturator prosthesis using vinyl polysiloxane. J Prosthet Dent 1991;66:60-3.

93.H.Serdar Cotert, Cenk Cura, Atilla Kesercioglu. Modified flasking technique for processing a maxillary resection obturator with continuous pressure injection. J Prosthet Dent 2001;86:438-40.

94.Roger M.Watson and Barry J.Gary. Assessing effective obturation. J Prosthet Dent 1985;54:88-91.

95.Kiyoshi Shimodaira, Hiroshi Yoshida, Masahito Mizukami, Takashi Funakubo. Obturator prosthesis conforming to movement of the soft palate: A clinical report. J Prosthet Dent 1994;71:547-51.

96.Huryn JM, Piro JD. The maxillary immediate surgical obturator prosthesis. J Prosthet Dent 1989;61:343-7.

97.Mark S. Chambers, James C. Lemon, Jack W.Martin. Obturation of the partial soft palate defect. J Prosthet Dent 2004;91:75-9.

98.Rhonda F. Jacob, Gordon King.Indirect retainers in soft palate obturator design. J Prosthet Dent 1990;63:311-5.

99.Sharry J. Meatus obturator in cleft palate prosthesis. Oral Surg Oral Med Oral Pathol 1955;7:852-6.

100.Taylor T and Desjardins R. Construction of the meatus type obturator:Its advantages and disadvantages. J Prosthet Dent 1983;49:80-5.

101.Yuuji Sato, Mihoko Sato, Koichiro Yoshida, Hiromichi Tsuru. Palatal lift prostheses for edentulous patients. 1987;58:206-9.

102.LaVelleW ,HardyJ. Palatal lift prostheses for treatment of palatopharyngeal incompetence. J Prosthet Dent 1979;42:308-12.

103.Robert L. Schneider, Thomas D Taylor. Mandibular resection guidance prostheses: A literature review.J Prosthet Dent1986;55:84-86.

104.Cantor R, Curtis T, Shipp T. Maxillary prosthesis for mandibular surgical defects. J Prosthet Dent1969;22:253-7.

105.Moore D. Glossectomy rehabilitation by mandibular tongue prosthesis. J Prosthet Dent 1972;28:429-32.

106.Robert E McKinstry, Mohamed A. Aramany,Quinter C.Beery, Frank Sansone.Speech consideratins in prosthodontic rehabilitation of glossectomy patients. J Prosthet Dent1985;53:384-9.

107.Da Breo E.L, David E.Schuller. Surgical and prosthetic considerations in the management of orbital tumors. J Prosthet Dent 1992;67:106-12.

108. Wolfaardt JF, Hacqueboard A, Els JM. A mold technique for construction of orbital prostheses. J Prosthet Dent 1983;50:224-6.

109.Jooste C, Bester D,Roets R. A mold technique for orbital prosthses. J Prosthet Dent1992;67:308-2.

110.Chambers MS, Lemon JC, Martin JW, Wesley PJ. A hybrid mold technique for fabricating facial prostheses. J Prosthet Dent 1996;75:53-5.

111.Jebril K.Acceptability of orbital prostheses. J Prosthet Dent 1980;43:82-5.

112.L. M.Sykes, A. R. M. Essop, E.M. Veres. Use of custom made conformers in the treament of ocular defects. J Prosthet Dent 1999;82:362-5.

113.Mark S.Chambers, James C. Lemon and Jack W. Martin. Anterior key method of indexing orbital prostheses. J Prosthet Dent 2002;87:102-5.

114.Hussein S. Zaki, Eugene N. Meyers. Prosthetic management of large nasal septal defects. J Prosthet Dent 1997;77:335-8.

115.Young JM. Internal nares prosthesis. J Prosthet Dent 1970; 24:320-3.

116.Seals RR,Bohnenkamp LG, Parel SM. Intra nasal prostheses,splints and stents.J Prosthet Dent1988;60:595-601.

117.Shobha Rodrigues, Vidya Kamalaksh Shenoy and Kamalaksh Shenoy. Prosthetic rehabilitation of a patient after partial rhinectomy: A clinical report. J Prosthet Dent 2005;93:125-8.

118.Darunee P. NaBadalung. Prosthetic rehabilitation of a total rhinectomy patient resulting from squamous cell carcinoma of the nasal septum:A clinical report. J Prosthet Dent 2003;89:234-8.

119.Nusinov NS,Gay WD. A method for obtaining the reverse image of an ear. J Prosthet Dent 1980;44:68-71.

120.Shimodaira K, Fukuda H ,Kanazawa T,Funakubo T. Techniques for superimposing a color slide onto a facial cast to sculpt a facial prosthesis. J Prosthet Dent 1969;62:212-3.

121.Robin W. C. Chung, Adam S. C. Siu, Frederick C.S. Chu, Talk W. Chow. Magnet retained auricular prosthesis with an implant supported composite bar: A clinical report. J Prosthet Dent 2003;89:446-9.

122.Russell Wang. Preoperative auricular wax pattern duplication for sugical template fabrication. J Prosthet Dent 1999;81:634-7.

123.Russell R. Wang, Carl J.Andres. Hemifacial microsomia and treatment options for auricular replacement: A review of literature J Prosthet Dent 1999;82:197-204.

124.Mark T. Marunick, Richard Harrison and John Beumer III. Prosthodontic rehabilitation of mid facial defects J Prosthet Dent 1985;54:553-60.

125. Jeffrey A.Rouse and Varoujan A. Chalian. Fabrication of hollow extraoral prostheses to enhance retention. J Prosthet Dent 1985;53:557-563.