PREVENTIVE PROSTHODOTICS

BY

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INTRODUCTION

Prosthetic dentistry is one of the fundamental pillars of dentistry. The most effective prosthetic prophylaxis could be the prevention of causes leading to tooth extractions. As a dentist our main aim should be prevention, which not only includes prevention of caries or periodontal disease but also prevention of residual alveolar bone loss after teeth are extracted. Modern treatment options improve the overall prognosis of the stomatognathic system and the quality of life of the affected patients significantly.

Preventive prosthodontics emphasizes the importance of any procedure that can delay or eliminate future prosthodontic problems.

Preventive prosthodontics refers to prosthodontic practices that help prevention of the factors adversely affecting the orodento-facial tissues and structures including, the tooth supporting structures such as periodontium, alveolar bone, basal bone and surrounding musculo-skeletal structures like muscles of mastication, salivary glands and the tissues in the head and neck region.

The loss of several teeth need not be an immediate threat to the function of whole dentition, but it can initiate serious problems related to oro-facial region and well being of the patient. In this perspective prosthetic dentistry is a valuable tool with high therapeutical and preventive character.

DEFINITIONS

PREVENTION: Prevention is defined as "actions taken prior to the onset of disease, which removes the possibility that a disease will ever occur".

PROSTHODONTICS: Prosthodontics is the dental speciality pertaining to the diagnosis, treatment planning ,rehabilitation and maintenance of the oral function, comfort, appearance and health of patients with clinical conditions associated with missing or deficient teeth and/or oral and maxillofacial tissues using biocompatible materials.(ADA)

OR
The dental speciality concerned with the making of artificial reoplacements for missing parts of mouth and other facial structures.

Preventive dentistry is defined as procedures employed in practice of dentistry and community dental health programs, which prevent the occurrence of oral diseases and oral abnormalities. Gerrine N.F

Preventive posthodontics emphasizes the importance of any procedure that can delay or eliminate future prosthodontic problem.

Goals of Preventive Prosthodontics:

1. To delay the residual ridge resorption
2. Preservation of followed in complete denture fabrication as well as fabrication of partial dentures whether removable or fixed.
3. Assess the need for early prosthodontic replacement of lost tooth / teeth.
4. Select treatment in consultation with patient and implement it judiciously.
5. Design prostheses not interfering with normal oro-dental hygiene procedures.
6. Act as team leader, guide colleagues & help prevention of future prosthodontic problems.

7. Plan to preserve what already exists than replacing what is missing.

Preventive Dentistry is a philosophy of dentistry, it comprises the various procedures used by dentists, dental hygienists, nurses. It consists of prevention of

1- Initiation of diseases (Primary prevention)
2- Disease progression and recurrence (Secondary prevention)
3- Loss of function (Tertiary prevention)

Operative dentistry consists of all procedures including preventive measures by which teeth may be conserved and thus maintain the natural masticating mechanism in such a state that the general health will not be endangered.

OBJECTIVES

1. Patients education and motivation
2. Selecting evidenced based management option / prosthetic type and design to maintain remaining teeth and their supporting tissues in healthy state.
3. Prostheses for preventing, stabilizing and controlling the progression of specific dento-orofacial conditions.
4. Special preventive prostheses for head and neck cancer (HNC) patients including preventive prostheses and radiation stents and carriers.

PART-1

PREVEENTION AT PRIMARY LEVEL

It is defined as action taken prior to the onset of disease/which removes the possibility that a disease will ever occur. It includes intervention pre-pathogenic phase of a disease .It includes the steps like health promotion and specific protection.

Health promotion:

- Dental caries prevention
- Oral hygiene
- Flossing (as shown in fig 1)

Fig:1 Flossing

- Plaque control
- Regular checkup for caries activity
- Diet counselling
- Caries vaccination, recall and checkup,
- Reinforcement of the oral hygiene measures

Dental caries prevention :

Saliva contains antibacterial proteins,electrolytes for remineralization but also the essential nutrients for bacteria to grow.However it is the food that is ingested by the host that provides the dietary carbohydrates that are easily converted to energy and acids by the bacteria that leads to dissolution of dental hard tissues(as shown in fig 2)

Fig:2 Dissolution of hard tissues

The disaccharides sucrose and the monosaccharides glucose, a componet of sucrose are most cariogenicand,with frequent ingestion, can cause severe damage to the tooth.

Plaque control

Preventive intervention aims to modify the steps in the repeat demineralization and remineralization cycles.

1. Neutralize the plaque acids: This can be done by adding base or adding buffers such as sodium bicarbonate to the saliva to boost its ability to neutralize acids (as shown in fig 3).

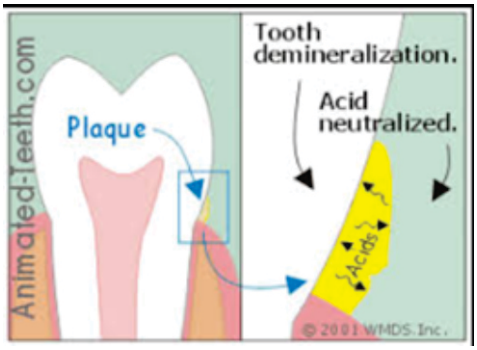


Fig:3 Neutralization of plaque acids

1. Improve hygiene: With bacterial levels low, less acid is produced. Also plaque layers don't have a chance to grow thick, saliva which can penetrate better into the enamel surface through thin layers of plaque.
2. Introduce antimicrobials: Since caries is a disease caused by bacteria, simply eliminating the bacteria or controlling their growth would not reduce the caries incidence. Chlorhexidine, xylitol, ozone, even experimental antibodies have been used to control bacterial growth.
3. Stimulate Saliva: Saliva contains numerous components that fight against tooth decay.
4. Topical fluorides: Flourides added to the remineralization incipient lesion increases the enamel crystals resistant to dissolution by plaque acids(as shown in fig 3)
5. Remineralizing strategies: Remineralization can be promoted with the use of calcium-phosphate complexes such as ACP-CPP.

Regular checkup for caries activity :

Caries activity: increment of active lesions over a stated period of time. Many of these caries activity tests require extensive work up time and additional equipment. Simple, inexpensive techniques, which do not demand, sophisticated skills or consume much time are required for the caries activity tests and the status they deserve in the routine clinical practice and epidemiological screening programs.

Stolpe J R classified it under 3 headings:

1. Tests concerned with chemical properties of Saliva
2. Tests concerned with bacterial constituents of Saliva
3. Tests which measure certain changes in chemical properties

produced by bacterial metabolism.

Uses :

- Establish a baseline level of cariogenic pathogens as a basis for future evaluation and counselling.
- Ensure a low level caries activity before starting any extensive procedures.
- To modify the patient behaviour as a part of counselling to restrict sucrose intake.

Advantages :

Identification of high risk population for dental caries and to institute effective preventive measures.

- In depth analysis of caries progression by researchers and to develop better control measures. Decreases the caries susceptibility at individual level.

Criteria for an ideal Caries activity test

- Should be simple & inexpensive
- Should be valid
- Should be reproducible
- Should be sensitive
- Should be measurable
- Should be non- invasive and applicable to any clinical setting

Diet counseling

The science which deals with the study of nutrient and foods and their effects on the nature and function of organism under different condition of age, health & disease. –NIZEL (1989) Nutrients are defined as the constituents of food, which perform important functions in our body.

Nizel (1989): Total oral intake of a substance that provides nourishment & supply (as shown in fig 4)

Fig:4 Balanced Diet plan

BALANCED DIET : One providing each nutrient in the (neither deficient nor excess) needed to maintain optimum health. - Stewart Diet

- Vitamin A deficiency produces hyperkeratosis and hyperplasia of gingival tissue. There is a tendency to periodontal pocket formation.
- A suitable anti-metabolite of vitamin K might interfere with the growth of Bacteroides Melaninogenicus and consequently, prevent the occurrence of periodontal disease.
- The characteristic oral sign of Vitamin C deficiency is scurvy which results in enlargement of the marginal gingiva that envelopes and almost completely conceals the teeth.

Effects of vitamin deficiency on Periodontium:

- Step 1: Ascertain the dental health diet score and if necessary, demonstrate the method for keeping a food intake diary
- Step 2: explain the nutrition-periodontal relationship
- Step 3 : Assess nutritional status
- Step 4 : Prescribe a diet –improve adequacy of diet
- Emphasize foods that are particularly beneficial to periodontal tissue- proteins, vit C, A, folic acid, calcium, iron and zinc (as shown in table 1)

Table No:1 Effects of Vitamin Deficiency

Deficiency	Systemic effects	Oral effects
Vitamin A	Xerophthalmia	Leukoplakia, Hyperkeratosis of oral epithelium
Thiamin B_1	Neuritis, Cardiac failure, Beriberi	None
Riboflavin B_2	Dermatitis	Angular stomatitis, Glossitis
Nicotinamide (Niacin B_3)	Pellagra, CNS, Diarrhoea, Dementia	Glossitis, Stomatitis, Gingivitis
Vitamin B_{12}	Pernicious anemia	Glossitis, Aphthae
Vitamin C	Scurvy	Gingival swelling, Bleeding
Folic acid	Macrocytic anemia	Glossitis, Aphthae, Atrophy of lingual papillae
Vitamin D	Rickets, Osteomalacia	Hypocalcification of teeth, Malformation

- Encourage the elimination of plaque forming sweets and substitution of fibrous foods. Nutrition counselling for a patient with chronic periodontitis
- Diet counselling makes the patient aware of the fact that diet plays an important role in the treatment of the disease.
- With today's emphasis on prevention of disease, diet counselling helps to reduce the risk of some illness by appropriate counselling.

According to an African Journal of Oral health by Etisiobi Ndiokwelu in a review stated that there is a close relationship between diet, nutrition and dental health. Oral tissues like all tissues in the body are diet and nutrition-dependent. Knowledge of food sources,their properties, functions, requirements, optimal levels and consequences of deficiencies must form the basis for dietary counselling. Enough is now known about the interdependence of nutrition, diet and dental diseases that dietary counselling has become a very important and integral part of dental care in developed countries. This is not surprising because oral tissues like all tissues in the body are diet and nutrition – dependent.

Topical fluoride application:

In case of the old patients due to decreased salivation, gingival recession, root exposure cervical abrasion, attrition, an increase risk of the caries susceptibility is there. So for these patients fluoride rinses and fluoridated tooth pastes are recommended. For professional use high concentration 1.23ppm fluoride gel can be used, Fluoride varnishes such as Duraphat 5% used with cotton bud,slow released devices are available(as shown in fig 5)

Fig :5 Fluoride application

The patient is also educated about the chewing habits, tongue postures for better maintenance of the occlusion and maintenance of the prosthesis.

Petersen PE (2004) concluded that water fluoridation and use of fluoride tooth-pastes and mouth-rinses significantly reduce the prevalence of dental caries. WHO recommends for public health that every effort must be made to develop affordable fluoridated toothpastes for use in developing countries. Water fluoridation, where technically feasible and culturally acceptable, has substantial advantages in public health; alternatively, fluoridation of salt and milk fluoridation schemes may be considered for prevention of dental caries

Mouth Guards

The mouth guards (as shown in fig 6)

Fig: 6 Mouth Guards

are indicated to prevent the dental and dentofacial injuries in contact sports.The injuries such as tooth fractures, concussion, crown root

fractures, TMJ fractures, dento-alveolar fractures, soft tissue injuries can be prevented or minimized. Use of mouth guards reduced the risk of dental and maxillofacial trauma <7.5%. The mouth guards with moderate resiliency absorb the forces, protect the teeth, TMJ and prevent the contact of teeth and thus prevents ankylosis.

The protection can be provided by various methods like providing the radiation docking (cone positioning) devices, making spacers in the interstitial brachy-therapy for tongue cancer and fabrication of tongue shields. Radiation locking devices are utilized for directing the radiation cones for a particular area of the oral cavity.

In many conditions, the radiation therapy has to be provided in divided doses. In those conditions, the locking device helps in the proper orientation of the radiation cones and also protects the adjacent soft tissue by deflecting them out of the radiation path. When other areas of the oral cavity are irradiated, the tongue needs to be protected. This can be done with the help of tongue shielding radiation stent (as shown in fig 7)

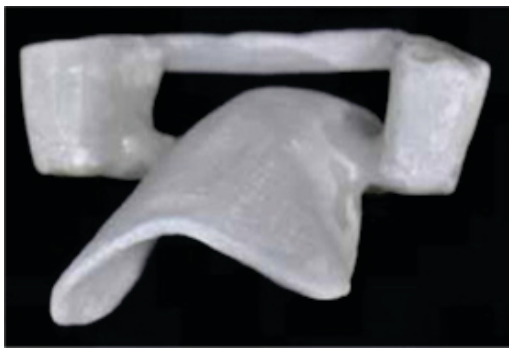


Fig:7 Tongue Displacing Stent

Radiation spacers:

A radiation spacer may be of mouth guard type, used for dentulous patients and replica denture type for edentulous patients. The thickness of the spacers should be around 10 mm for proper attenuation of the radiation.

Rationale: As the distance increases the radiation effect reduces in its intensity. At 10 mm distance radiation energy is reduced by 60% to 70% and prevents the complications like mucositis, radiation caries and osteoradionecrosis.

Tongue shielding radiation stent:

Terence J. Fleming, stated that Protective stents are stents fabricated to protect the lateral border of the tongue during therapeutic radiation therapy delivered to a unilateral region such as used in treating parotid or retromolar lesions. The use of radiation-protective stents markedly minimizes the treatment sequelae from therapeutic irradiation.The tongue is protected or it will become inflamed, making speech and swallowing extremely painful . Santiago, 1965 stated that these prosthesis administer radiation to a confined region by means of capsules, beads or needles of radiation emitting materials.

PREVENTIVE PROSTHODONTICS AT SECONDARY LEVEL

Preventive prosthodontic procedures which can be performed at this level are-

- Occlusal interference correction
- Treatment for bruxism
- Treatment for trauma from occlusion, Correction of plunger cusps and
- Treatment of obstructive sleep apnoea.
- **Occlusal interference:** produces mandibular deviation during closure to maximum intercuspation (MIC) position or may hinder the smooth passage to and from MIC position. The inference may be present during latero-trusive movements and protrusive movements. If the occlusal interference cross the threshold of adaptive capacity of the Temporo-mandibular joint, muscles of mastication and neuromuscular system, it leads to muscle hypertrophy, muscle fatigue, spasm, headaches, cranio-mandibular dysfunction syndrome, wear facets, fractured cusps and tooth mobility. So correction of occlusal interference is recommended in the early stages. Care should be taken during the occlusal correction, if not it may aggravate the situation.
- **Bruxism:**leads to attrition, mobility, muscle hypertrophy, occlusal facets, alveolar bone loss and TMJ disorders. If occlusal interferences are present, the patient tries himself to equilibrate the occlusion and thus develop the habit of clenching or grinding of teeth. This can occur due to periodontitis, overcontoured restoration, psychological and physical stresses, sleep disorder, central nervous system disturbances and alcohol.

Symptoms include Muscle soreness, Fatigue of masticatory muscle early in themorning, Hypermobility,Hypercementosis, Cusp fractures , Pulpitis , Break in lamina dura and Furcation involvement.

Treatment:
Controlling the psychological stress

Fig: 8 Occlusal Splints

Occlusalsplints (as shown in fig 8) or intraoral orthoses.
Occlusal correction
Coronoplasty

It is a reversible condition, when occlusal forces exceed the adaptive capacity of the periodontal tissues and results in tissue injury. This tissue injury is called as TFO (trauma from occlusion). Acute TFO is due to sudden heavy forces. Chronic TFO is due to continuous and long duration occlusal forces, e.g. bruxism, drifting and extrusion of the teeth. Primary TFO is caused due to high occlusal forces whereas main cause of secondary TFO is a low threshold or low resistance of the periodontium. occlusal corrections are needed for the correction of the TFO.

Plunger Cusp:
The cusps which wedge the food forcefully into the interdental spaces of the opposing arch. These plunger cusp are usually the functional cusp and sometimes palatal incline of maxillary buccal cusp and buccal incline of lingual cusp.

Treatment:
Involves rounding and shortening of the plunger cusps, and the opposing interproximal space is protected by splinting the adjacent teeth.

- **Obstructive sleep Apnea:**

It is characterized by cessation of airflow through upper airway while diaphragm movement continues. It can be caused due to enlarged

tonsils, enlarged soft palate, large tongue and retrognathism. The role of dentistry in sleep disorders is becoming more significant, especially in co-managing patients with simple snoring and mild to moderate obstructive sleep apnea.

Treatment:
Fabrication of prosthetic mandibular advancement appliances like
Soft palate lifters
Tongue retainers
Mandibular repositioners
Surgery to remove portions of the soft palate and uvula.
Snore guards (as shown in fig 9)

Fig : 9 Sleep Apnea Oral Appliances

Common Features in Patients with Sleep Apnoea:
Loud snoring
Disrupted sleep
Nocturnal gasping and choking
Daytime sleepiness
Fatigue

The occlusal interferences, particularly balancing ones, are primarily detrimental during the act of mastication. Schuyler considered that balancing contacts get damaged during mastication, and Landa in a roentgenographic study, had suggested that balancing contacts during chewing may injure the temporomandibular joint. Some recent experimental methods for the analysis of mastication are based upon electronic devices which are capable of recording both tooth contacts and electromyography. Through the use of such tele-metering equipment, it should be possible to find out whether or not masticatory tooth contacts

are related to the etiology of occlusal trauma and other disorders of the masticatory system.

Preventive Prosthodontics at Tertiary Level:
It involves limiting the disability of the patient and rehabilitation. Prosthodontic rehabilitation incorporates procedures like post and core treatment, removable partial denture, fixed partial denture ,implants, treatment of decayed teeth, root canal treatment and extractions.

Prosthodontic Option in Disability Limitation and Rehabilitation: W.Kalk vanwaas (1990) presented the "preventive prosthetic treatment strategy" which includes-

- Restoration of the teeth, Timing of extraction, Preservation of occluding pairs of teeth,
- Avoidance of contact between the teeth and the opposite edentulous jaw.
- In rehabilitation phase: planning for the immediate dentures, treatment dentures or interim dentures, complete dentures and provisional restorations can be done.

Timing of Extraction:
Planned extraction of highly mutilated teeth prevents the rapid resorption of the alveolar ridges. Careful extraction should be done to avoid the presence of unantagonized tooth. If antagonists are not present, supra eruption of opposing dentition leads to contact between the mucosa and teeth of the opposing arches. As a result, arch stability is lost, and this leads to severe resorption of the alveolar ridge in edentulous arch. Extraction of the maxillary third molar is delayed till the middle age. As third molars have their influence on growth of the tuberosity and help in the development of anterio-posterior alveolar ridge. In case of impaction of third molars care should be taken such as minimal stripping of the periosteum, minimal damage to the bone and use of prophylactic antibiotic. In patients who have had radiotherapy every possible precaution should be taken.

Restoration of teeth:
A dental restoration or dental filling is a treatment to restore the function,integrity,and morphology of missing tooth structure resulting from caries or external trauma as well as to the replacement of such

structure supported by dental implants.PRR (Preventive Resin Restoration) integrates preventive approach of the sealant therapy for caries susceptible pits and fissures with the therapeutic restoration of incipient caries with composite resin that occurs on the same occlusal table.

Preservation of occluding pairs of teeth:

Many people wear complete dentures with varying degrees of success. The ever growing population and the increased life expectancy suggest that the demand for complete denture service will escalate in spite of the heroic efforts of preventive dentistry. Many varied concepts exist regarding the best way to establish the occlusion for complete dentures. The increasing demand for denture service compels the dentist to seek an effective and uncomplicated procedure based on functional efficiency and preservation of supporting tissue. Neither uniformity nor rigid standardization of technique is advocated. The basic concern is the application of sound basic concepts of occlusion which will perform as effectively as possible in the edentulous environment.

Payne, discussed the selection of artificial posterior tooth forms. There are three basic schemes for posterior occlusion .The spherical scheme: Anatomic teeth are used, and they may be altered. This scheme appears in natural dentitions unless severe abrasion is present. Balanced occlusion rarely exists in the natural teeth, but balance is desirable for complete dentures.

The flat scheme: Non-anatomic teeth are used. Balanced occlusion does not exist unless compensating curve balancing inclines are used.

The reverse curve: Modified anatomic teeth may be used, but usually nonanatomic teeth without balancing contacts are employed. Balance is possible by introducing a spherical buccal incline in the posterior region of the occlusion. This is called a “Pleasure curve” after Dr. Max Pleasure who suggested it. In the treatment of mutilated dentition, preservation of an incomplete dentition with a minimum of occluding pairs of teeth in combination with a partial denture is preferable than the total tooth extraction. This is advantageous for utilization of the natural teeth for retention and stability of the prosthesis. Presence of the periodontal ligament provides the advantage of biofeedback mechanism in controlling the occlusal forces.

Interim Dentures/Treatment Denture:

In the early loss of the permanent teeth, if the definitive treatment cannot be done for various reasons, the treatment dentures can be utilized as preventive measures.

The treatment dentures act as space maintainers to, prevent the migration/drifting, supra eruption and contact between the teeth, alveolar ridge, to restore the function, esthetics, restore the muscular tonicity, vertical height, jaw health and avoids the abnormal jaw habits.

Smith DE stated that Improvement in the interim denture procedure in the past decade has been one of the significant advancements in prosthodontic practice. The interim denture approach is only slightly more time-consuming and expensive than the conventional immediate denture approach, yet it has many advantages.

Among those advantages are the following:

(1) Allows rapid results;
(2) Results in a higher quality definitive denture;
(3) Allows the surgical treatment to be performed during one appointment;
(4) Permits duplication of the natural tooth position; and
(5) Provides the patient with a spare denture after the definitive denture is completed. An interim denture technique was described that utilized a flexible layered silicone mold to form the replaced teeth. The interim denture procedure is flexible and lends itself to many variations in technique to meet unusual clinical situations. An interim removable partial denture technique was described that involves block-out of undesirable undercuts and duplication of the master cast for fabrication of the partial denture.

Immediate Dentures:

Immediate denture is a dental prosthesis constructed to replace the lost dentition and associated structures of maxilla and mandible and inserted immediately following removal of remaining teeth. An immediate denture must be compatible both biologically and physiologically with the oral environment. It should restore mastication,speech and deglutition to as near normal as possible. It must also be aesthetically compatible and preserve the remaining oral tissues.

Immediate denture presents numerous advantages such as,

a) The denture acts as a protective splint for the extraction wound and prevents injury,
b) Protection of the blood clot
c) No compromise in functions of oral cavity like speech, deglutition and mastication
d) No period of edentulousness for the patient and
e) Maintaining of vertical dimension of occlusion.

Though the advantages are seemingly convincing, it also has disadvantages like:

a) Stimulation provided by the natural teeth is absent
b) It involves a precise and time consuming protocol
c) Absence of anterior try in for aesthetics.

Richardson (I860) described the use of immediate denture.(as shown in fig 10)

Fig:10 Immediate Denture

If the dentition is very compromised and indicated for total extraction, then immediate dentures are planned for the following. Promote better healing (immediate dentures act as surgical stents).These stents apply minimal pressure to the soft tissues, facilitates healing, prevent the cicatrisation or tissue collapse. Protect the blood clot and aids early healing. Promote better ridge form.

Provisional Restoration:

After the tooth preparation is done for fixed prosthesis, provisional restoration is advocated to prevent the events like pulpal inflammation (pulp protection), mesial migration, supra eruption and arch integrity,

protection of the tooth preparation margins (e.g., partial veneer crown) and protection of the periodontium. Clinicians have many choices of provisional materials from which to choose when fabricating provisional restorations which provides esthetic value to the patient.

Complete Denture:

When the teeth are completely absent in any one of the arch, the fabrication of a single complete denture is highly recommended to prevent the contact of the teeth and alveolar ridge, to restore function, vertical dimension, esthetics and prevent the development of parafunctional habits.

The complete dentures are provided for edentulous patients (edentulous in both jaws) to rehabilitate them by restoring the function form and aesthetics and general health of the patients. The complete dentures are provided with various occlusal schemes such as balanced occlusion, lingualized occlusion, neutrocentric concept and others depending upon the condition of the patients.

Balanced occlusion involves :
A definite arrangement of tooth contacts in harmony with the mandibular movements, and if the positions, dimensions and occlusal surfaces of the teeth are such that during functional jaw movements, mandibular cusp blades contact maxillary cusp blades throughout the dentures, those dentures can perform their masticatory function most effectively, and their Occlusion may be termed as 'physiologic occlusion' or 'balanced occlusion', Ronwill in 1864, who has been called “the father of anatomic (balanced) three point contact occlusion” to the present time, all the theories which were studied seemed to be based upon the assumption that the articulator moves similar or equivalent to the mandible.

The spherical scheme by Kelly (Anatomic teeth are used) appears in natural dentitions unless severe abrasion is present. Balanced occlusion

rarely exists in the natural teeth but balance is desirable for complete dentures. Advantages of this scheme are

I. Stability of the denture bases
ii. Preservation of supporting tissues
iii. Required during the time of mastication and parafunctional habits

The flat scheme Non-anatomic teeth are used. Balanced occlusion does not exist unless compensating curve, balancing inclines are used. Advantages of this scheme are

- Adapt better in unusual jaw relationship
- Do not lock the mandible, provide the sense of freedom
- They eliminate horizontal forces that are more damaging than vertical forces

The reverse curve Modified anatomic teeth may be used, but usually non-anatomic teeth without balancing contacts are employed. Balance is possible by introducing a spherical buccal incline in the posterior region of the occlusion. This is called a "Pleasure curve" - Dr. Max Pleasure who suggested it.

Neutrocentric:
It is a term used to suggest a concept with two key objectives in the making of a denture by (Devan 1954)

1. Neutralization of inclines
2. Centralization of forces acting on the denture foundation.

To attain these objectives it may be necessary to
a) Reduce the size and number of teeth.
b) Abandon attempts to secure balancing contacts in eccentric positions beyond the range of masticatory stroke.

The five elements of this scheme were:
- **Position:** He positioned the posterior teeth over the residual ridges as lingual as the tongue would allow so that forces are perpendicular to the supporting areas. This avoided tensile and shearing forces.
- **Proportion:** He reduced the tooth width by 40% that reduced the vertical stress on the ridge. Horizontal forces are reduced because the

friction between the opposing surfaces is decreased. The forces are thus centralized without encroaching the tongue.

- **Pitch:** This is the inclination of the occlusal plane. It is oriented parallel to the underlying ridge and midway between them. This directed the forces perpendicular to the mean osseous foundation plane.
- **Form:** Flat teeth with no deflective inclines were used so that there are no interferences to mandibular movements.
- **Number:** The number of posterior teeth was reduced from eight to six. This reduced magnitude of and centralized it to second premolar and first molar.

Occlusion developed with this scheme provides the following advantages.

1. Satisfactory preservation of ridge bone.
2. Good denture stability, good appearance, adequate speech and mastication.

Linear Occlusion:

It is defined as "The occlusal arrangement of artificial teeth, as viewed in the horizontal plane, where in the masticatory surfaces of the mandibular posterior artificial teeth has a straight, long, narrow occlusal form resembling that of a line, usually articulating with the opposing monoplane teeth."

William H Goddard is credited for the introduction of linear occlusion. Gronas and Stout explained how both anatomic and non-anatomic occlusal schemes transmit significant lateral forces to the denture bases, and they suggested that the linear occlusion had the potential for creating the smallest lateral force component.

Basic parameters:

- Zero degree teeth (Flat teeth) are opposed by bladed (line contact) teeth in which the blade is in straight line over the crest of the ridge
- The arch, which requires the greatest stability, may receive the bladed teeth.
- Mandibular teeth are set to flat occlusal plane
- There is no anterior tooth interference to protrusive or lateral movements
- This non-interceptive occlusion provides a consistent vertical seating force in both centric and eccentric movement; hence, transverse vectors are essentially eliminated.(as shown in fig 11)

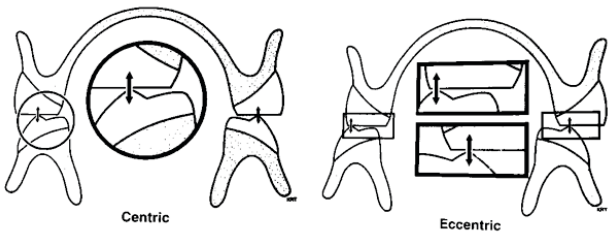


Fig:11 Concepts of occlusion

Over dentures:

Barker (1861) reported first use of Overdentures to the American Dental Convention. An overdenture is a removable dental prosthesis that covers and rests on one or more remaining natural teeth, the roots of natural teeth, and on dental implants. The implants or modified natural teeth provide for additional support, stability; and retention of the overdenture than the edentulous ridges alone can provide. This is particularly advantageous in the mandibular arch, where edentulous ridges may resorb at a rate four times greater than that of the maxillary arch. It is also known as Hybrid dentures or tooth-supported complete dentures. Retaining natural teeth as abutments for dentures can considerably reduce the progress of residual ridge resorption. Multiple abutments can be used for this purpose.

Indications for Overdentures:

1. For better support and aesthetics in morphologically compromised dental arches.
2. Cleft palate cases
3. Dentures for patients with maxillofacial trauma.
4. Patients with worn-out dentition
5. Forcongenital anomalies like microdontia, amelogenesis imperfecta, dentinogenesis imperfecta and partial anodontia.
6. Patients with abnormal jaw size and position where orthognathic surgery is contraindicated.

This treatment is usually indicated for:

Group I: Patients with few remaining teeth that may be healthy or periodontally involved, with intact or grossly destroyed crowns.

Group 2: Patients with severely compromised dentition. Selective extraction should be carried out after a thorough examination of the patient.

General Considerations during Diagnosis and Treatment Planning for an Overdenture:

Maintenance of Periodontal Health:

Once an overdenture is planned and constructed, it is the duty of the patient to maintain his teeth free from plaque. The dentist should check for pocket formation around the abutments. Failure to do this may lead to the loss of an abutment.

Reduction in Crown-root Ratio: Reduction in crown size during abutment preparation can be beneficial for the tooth, as it reduces the crown-root ratio and decreases the leverage forces acting on the tooth.

Success of Endodontic Therapy:

Endodontic therapy may be necessary for most abutment teeth because they need extensive crown reduction. A two-to-four week interval should be provided after completion of endodontic therapy in order to determine its success before starting further treatment.

Adaptation and Coverage of Denture-Bearing Area:

The denture base should be well adapted to the soft tissues in order to prevent accumulation of food debris and to evenly distribute the forces acting on the denture.

Design of the Denture:

As the denture base for overdentures are thin, they have to be reinforced with metal. At the same time they should be easy to fabricate and maintain.

Ease of Use:

The patient should be able to easily insert and remove the denture without any harm to the denture base or the abutment tooth.

Advantages of Overdentures:

1. Maintains the integrity of the residual ridge.
2. Improves the retention and stability of the denture.
3. Improved proprioception leads to better neuromuscular control. This helps in regulating the biting force over the denture.
4. Psychological effect on the patient as extraction can be avoided.
5. It can almost be used universally.
6. Even if there is abutment failure, the abutments can be extracted and the overdenture can be relined and used as a conventional complete denture.

Disadvantages of Overdentures:

1. Nutritional counselling, oral hygiene measures and fluoride application should be carried out periodically.
2. High incidence of caries and periodontal disease around the over denture abutments.
3. Frequent reviews are needed to verify the health of the supporting tissues of the overdenture abutments.
4. More expensive than conventional dentures because:

a- Endodontic therapy and coronal restorations may be needed for certain overdenture abutments.
b- Most cases need a cast metal denture base, as acrylic is weaker.
c- Additional designing and laboratory work is needed.

5. Cannot be used in cases with reduced interarch space, bony undercuts adjacent to the abutments, etc.
6. Improper maintenance of the overdenture may lead to periodontal breakdown of the overdenture abutments and the patient may lose all his remaining teeth.

Overdenture is a complete or partial denture prosthesis constructed over existing teeth or root structure, it's not a new concept in a technical approach to a prosthodontic problem. Indeed it was used 100 years back.

INDICATIONS

Patients with poor prognosis for complete dentures

In maxilla – in cases with excessive vertical overlap of anterior teeth
Unilateral overdenture when bone loss is excessive on one side of the arch

CONTRAINDICATIONS

- Lack of patient acceptance
- Lack of proper oral hygiene and periodontal tissue maintenance
- When other treatment modalities promise superior results
- Cost considerations

EXAMINATION, DIAGNOSIS, TREATMENT PLANNING AND PROGNOSIS
EXAMINATION OF THE OVERDENTURE PATIENT

- History and records
- Visual and digital examination – pathology, health of the supporting tissues
- Radiographic examination
- Treatment planning

ABUTMENT SELECTION

The choice and number of abudments are determined by a combination of load-bearing ability of the abutment teeth plus the forces and stresses to which these will be subjected .The number of roots, their shape, length, alignment and bone height has a direct relation to the load bearing capacity of teeth. The shorter,more tapered the root and lower the bone level, the less satisfactory the tooth will be as an abutment.

Evaluate the abudments for:

1. Periodontal status
2. Caries susceptibility
3. Potential for endodontic treatment
4. Positional considerations

LOCATION OF ABUTMENT TOOTH – Positional considerations of abutment tooth in the arch and its position should be between the buccal and lingual cortical plates which are areas of maximum force and ridge resorption potential . Best choice of abutment is canines and premolars . In maxillary arch, incisors are used at least one tooth per quadrant but ideal is two teeth per quadrant. The stress is distributed over a rectangular area. A tripod approach can also be used. Most commonly used teeth in the mandible for abutment is canine.

OVERDENTURE ABUTMENT MANAGEMENT

1. Non coping preparation
2. Coping preparation
3. Attachments

NON COPING ABUTMENTS

Selected tooth abudment are reduced to a coronal height of 2 to 3mm, the crown is contoured to a convex or dome shape the tooth is endodontically treated and filled with amalgam or composite restoration

COPING PREPARATION

A coping is a cover for the exposed tooth surface and cast metal copings with a dome shaped surface (as shown in fig 12) and a chamfer finish line at the gingival margin is prepared.

Fig: 12 Metal Copings over prepared teeth

Short copings: 2-3mm long, RCT done, Copings are with a post, canals filled with GP

Long copings: 5to 8mm long, RCT is not a must, Copings are long

ATTACHMENTS IN OVERDENTURES

Attachments are small precision devices which are incorporated to provide some additional benefits like retention and support, more retention can be gained by lengthening the post and the use of pins. It consists of two units: 1. Male 2.female

REQUIREMENTS FOR THE ATTACHMENTS

- The patients should have a low caries index
- Perform proper home care
- Sound periodontal health
- Abutment teeth with proper bone support

DISADVANTAGES OF ATTACHMENTS

- Added time
- May cause increased stress on the tooth
- More difficult to construct
- Requires careful manipulation by the patients.
- (Therefore is not of use for the mentally and physically handicapped)
- More expensive
- Reconstruction in the case of damage is difficult Added risk to the abutment due to caries and periodontal disease if poor oral hygiene is performed by the patient

STUD ATTACHMENTS

Fig:13 Anchor/Stud Attachment

Stud attachments(as shown in fig 13) consisted of a female part which is frictionally retained over the male stud and incorporated into the denture resin either by the means of a transfer coping system and the creation of a master cast incorporating a replica of the attachment or directly in the mouth using self-cured or light-polymerized resin. The stud attachments are classified according to function into resilient and non-resilient attachments. Resilient attachments permit some tissue ward vertical and rotational movements, thus protecting the underlying abutments or implants against overload. However, resilient attachments usually require a large space and might cause posterior mandibular resorption with the vertical movement of the denture. On the other hand, the non-resilient type does not permit any movement of the overdenture during function and were commonly employed when the interocclusal space was limited.

One of the main advantages of stud attachments is the ability of its use in cases with V-shaped arches where the straight connection between the implants can aect the tongue space

GERBER ATTACHMENT: This attachment is of two types:
Rigid attachment: That does not allow the movement of the base

Rigid type: It is most popular and widely used it consists of male post threaded on to a screw attached to a soldered base and female housing part contain spring and ring. Both the types are easily replacable(as shown in fig 14)

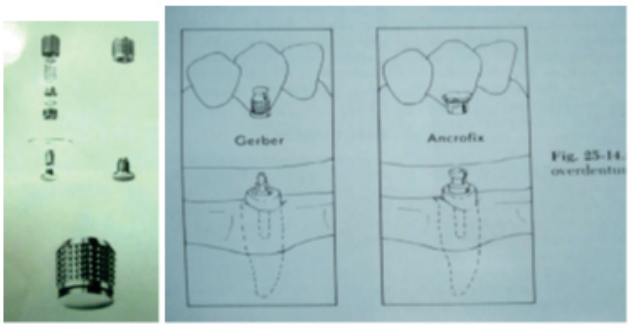


Fig :14 Gerber Attachment

DALBO ATTACHMENT
It is rigid, resilient or the stress breaker type. Male part is soldered to the tooth and the housing to the base.(as shown in fig 15).

Fig:15 Dalbo Attachment

The rigid type has a cylindrical male unit with a rounded head ,the resilient type is the smallest and the most commonly used sphere shaped male unit which allows rotational and vertical movements of female around male.

CEKA ATTACHMENT

In this type of attachment the male part affixed to the tooth and has a rounded shape wider at the top and split vertically into 4 sections. They are flexible and can be compressed the female housing fits over this (as shown in fig 16).

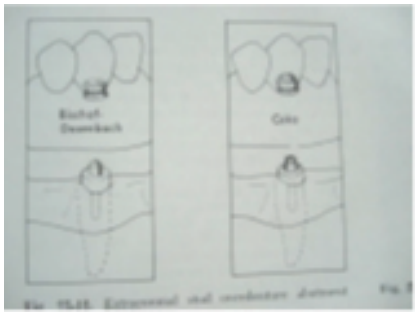


Fig :16 Cekaattachment

The attachment can also be constructed with a different type of retention male component that has a space between the parts to allow both rotational and vertical movements

ZEST ANCHOR

Ideal for interim overdenture (as shown in fig 17)

Fig:17 Zest Anchor

It derives its retention from the root a post preparation is made within the root and the female sleeve is cemented into place the male portion consists of a nylon post and a ball head attachment to the overdenture as a chair side procedure and the post is placed in the sleeve and the overdenture is placed over it with a self cure resin.

ADVANTAGES:
Overcomes any space problem because attachment is within root structure. Leverage to the abutment tooth is negligible since point of attachment is below alveolar bone level.

DISADVANTAGES :
Caries susceptibility as no coping placed
Nylon stud can bend preventing seating
To correct this frequent recall visits are necessary
When eating foods without the OD can cause food to stagnate in the female part

ROTHERMAN ATTACHMENT
This attachment is of two types : resilient and non resilient
Resilient allows both vertical and rotational movement..The male part consists of a groove deeper at one end than the other, it easily attaches to the coping with free hand soldering. The housing contains a 'C' shaped ring(as shown in fig 18) the ends of which fit in the deepest part of the retaining groove.

Fig:18 Rortherman Eccenrtric Attachment

INTROFIX ATTACHMENT
Stud attachment composed of a solder base an adjustable split male post and a female housing (as shown in fig 19)

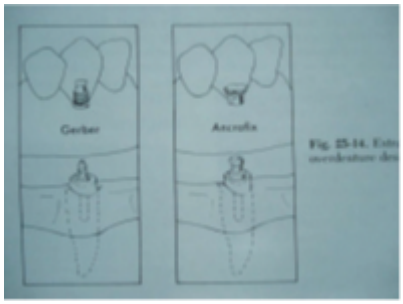


Fig:19 Introfix Attachment

The design is simple and provides frictional attachment between the two parts. The male stud has a longitudinal split that can be attached to provide more or less retention. It is replaceable as it is screwed to the solder base .The lengthy stud can produce a torque potential so it is used in only totally tooth supported system or OD with excellent support.

OTHER ATTACHMENTS The other attachments of importance: (as shown in fig 20)

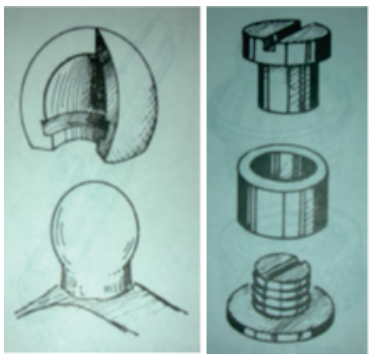


Fig: 20 Parts of Attachment

– Schubiger attachment
– Ancrofix attachment
– Quinlivan attachment

BAR ATTACHMENTS
The bar attachment consists of a metallic bar that splints two or more implants or natural teeth spanning the edentulous ridge between them and a sleeve (suprastructure) incorporated in the overdenture which clips

over the original bar to retain the denture. The bar attachments are available in wide variety of forms,(as shown in fig 21)

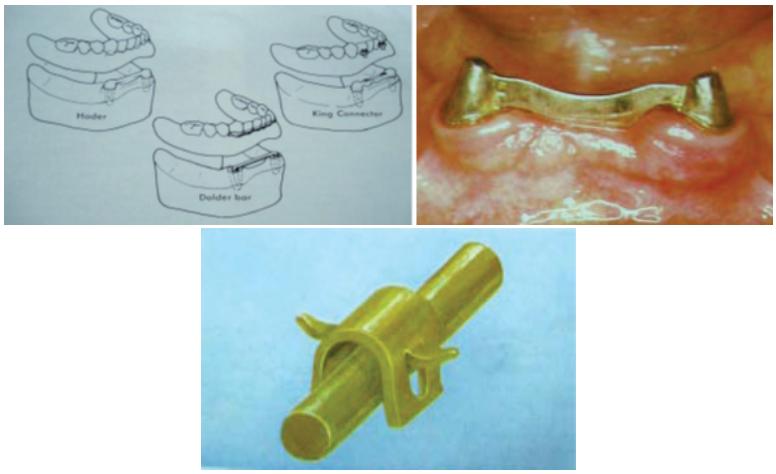


Fig: 21 Different Bar Attachments

They could be prefabricated or custom made.There are two basic types based on the shape and the action performed: Bar joint that permit some degree of rotation or resilient movement between the two components. Spacers should be provided to ensure a small gap between the sleeve and the bar during processing. Bar joints are subdivided into two types: Single sleeve and multiple sleeves; the single sleeve has to run straight without allowing the antero-posterior curvature of the arch, so it is used in square arches. On the other hand, the multiple sleeves can follow the curvature of the arch. It also enables the use of more than one clip. Bar units that provide rigid fixation of the overdenture allowing no movement between the sleeve and the bar.The prefabricated bars are preferred to milled bars as they are less expensive and more solid with an equal cross section. Prefabricated bars are either round, ovoid, or rectangular (U-shaped). Round bars offer more denture rotation than rectangular bars, so produce less torque on implants. However, Round bars require more frequent clip activation than U-shaped bars.

Therefore, oval or U-shaped bar are preferred when using two implants. The bar and clip attachments are probably the most widely used attachments for implant tissue supported overdentures as they offer greater mechanical stability and more wear resistance than solitary

attachments. In addition, short distal extensions from rigid bars can be achieved which contribute to the stabilization and prevent shifting of the denture. The assumed advantage of bar attachment is the better transmission of forces between the implants due to the primary splinting effect, load sharing, better retention, and the least post insertion maintenance

MAGNET

Magnetic retention is a popular method of attaching the removable prosthesis to either retained roots or osseointegrated implants. The magnet is usually cylindrical or dome-shaped attached to the fitting surface of the acrylic resin base of the overdenture (as shown in fig 22).

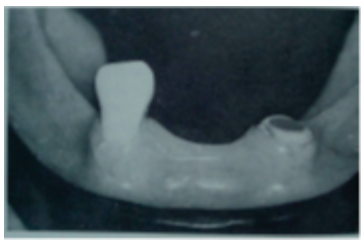


Fig:22 Magnetic Attachments

The magnetic keeper is casted to a metal coping and cemented to root surface or screwed over the implant fixture.The magnet system used for overdenture retention incorporates the magnet into the overdenture which is a neodymium-iron-boron alloy or a cobalt-samarium alloy. The second part of the magnetic system is the ferromagnetic keeper which is screwed into the implants. The retention force of magnet attachments in implant retained mandibular overdenture treatment is markedly less than the retention force of ball and bar/clip attachments. The immediate loading of magnetic attachment retained mandibular implant overdentures is considered as a viable treatment option in cases of the complete edentulous patient that increase retention and stability of conventional dentures .

BASED ON TYPE OF OVER DENTURE

- **Immediate over denture** : Constructed prior to preparation and ready for insertion after preparation & reduction . It enhances patients ability and adaptability to wear dentures.

- **Interim over denture** : Used for patients in transition or preparation phase until permanent overdentureis constructed . Patient old partial denture can be modified and used by extending the denture and by adding new artificial teeth using self cure acrylic resin.
- **Remote or Definitive over denture** : Conventional complete over denture is constructed over one or more abutment teeth. Could be made entirely of acrylic resin or in conjunction with metal bases.

Vital rootSubmucosal section.

Kotwal and Guyers have suggested that the root might be sectioned off surgically 2-3 mm below the alveolar crest and the wound closed. The pulp remnant is nourished from each end and can be expected to remain vital. The alveolar bone organizes above the root face and the root thus maintains the alveolar bone contour. This form of treatment might be contraindicated in an older person, but may be ideal for a younger patient. The root is likely to emerge at a later date due to resorption of the bone above it, but endodontic therapy could then be carried and either a new denture constructed or the existing one modified. An advantage of this method is that the patient contribution is reduced to a minimum and that it permits further intervention at a later stage.

Supramucosal section:

Vital roots may be retained supra-mucosally where the pulp has receded to the extent that the crown may be removed near the gingival crest without exposure. The root face may be restored by a cast gold cap and a denture constructed over it.

Pulpless root

Endodontic therapy of the highest standard is necessary when this method of root retention is chosen.

Subgingival section:

The root may be surgically sectioned below the alveolar crest as before and the wound is closed. The sub-gingival procedure is still largely experimental, but it seems that when the pulp remnant is vital the success rate is greater.

Supragingival section:

This means of treatment is most commonly employed. It is characterized by the de-coronation of the root **0.5-1** mm above the healthy gingival

margin and the restoration of the root face either by sealing the **pulp** canal orifice with amalgam or with a pin retained root cap, by the insertion **of** simple retentive device or, in selected cases, by the construction of a cast post retained root cap to which a precision attachment anchor is soldered.

Retaining the vital roots retarded the resorption of the residual ridges under complete dentures. These retained vital roots serve as natural implants which are ideal and anchored by periodontal ligaments.

The teeth are sectioned to the level of remaining healthy alveolar ridge. The cut ends are beveled to make it continuous with the alveolar bones, followed by exchange by muco-periosteal flap. Immediate complete denture is provided to stabilize the wound and proper healing.

Advantages: Patients need not worry about the maintenance of the submerged roots. Chances of caries and periodontal destruction around the submerged teeth are minimal.

In the course of time if the roots are emerged into the oral cavity. They can be used as over denture abutments.

Other advantages: Good retention and stability to the denture.

Surgical stents:
Stents can be used to apply pressure to the soft tissues to facilitate healing and prevent cicatrisation or collapse, (collumellar stent, periodontal pack or stent).

Indications:
- extraction of impacted canines,
- partial or segmental resection of maxilla and mandible,
- hemi maxillectomy, hemi mandibulectomy.
- Also in stabilizing the implants and ridge augmenting materials.
- Protect the wound site, allow unevenful healing, prevent cicatrisation, and provide the favourable ridge form.
- Also used after the frenectomy,vestibuloplasty,relocating the muscle attachments.

Obturator:

Obturator (as shown in fig 22)

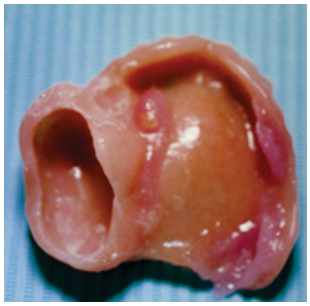


Fig:22Obturator

is a prosthesis used to close a congenital or acquired tissueopening, primarily of hard palate and contiguous alveolar tissues.

Immediate Obturator

- Surgical obturators are placed immediately after the surgery with or without surgical packing.
- It is retained by screws or wire fixation.
- It re-establishes the oral contours.
- Prevent the regurgitation of the fluids into nasopharynx.
- Protect the wounds and allows uneventful healing.
- Prevent the cicatrisation or shrinkage.

Interim obturator:

Interim obturator is given after the removal of the surgical packing The interim obturator is retained upto 3 months with repeated checking and relining with the tissue conditioner followed by definitive obturator.

FUNCTIONS:

- Feeding purposes.
- To keep the wound or defective area clean
- Enhance the healing of traumatic or post surgical defects.
- To reshape and reconstruct the palatal contour and/or soft palate.
- It also improves speech or, in some instances, makes speech possible.
- As a stent to hold dressings or packs post operatively

Role of Removable Partial Denture:

Every dental prosthetic treatment is associated with the placement of a foreign object (the prosthesis) in the mouth of the patient.The extent and direction of movement of RPD's during its function are influenced by the nature of the supporting structures and the design of the prosthesis.The service expectancy of the partial denture will be proportional to the degree of control of various stresses of this particular type of prosthesis that it should be emphasized by analyzing each stress and suggesting clinical and construction procedures for bringing about the most effective control. Functional stress stimuli ,within certain limits,are necessary for the maintenance of the supporting structures.Since forces are transmitted to abutment teeth through rests,guideplanes and direct retainers during functional movements,optimum design based on the best available research data will preserve the health of abutment teeth and their supporting structures.

The principle stresses, which are included by RPD are stresses:
1. Resulting from an inaccurate appliance design
2. Caused by an inaccurate appliance size
3. Which may cause impingement of the gingival structure and
4. Which torque or twist the abutment.

Stress Breaker:

"Whether or not a stress breaker should be used" will be a continuous dispute. McCracken states that, stress breaker has been used as a means to compensate for inappropriately designed removable partial denture.

Precision attachments in stress breaking:

Precision attachment is defined as "a specially machined, direct retainer for a removable partial denture. They consists of male and female part one of which is attached to the denture and the other to the abutment teeth".

Although there are few scientific data to aid in attachment selection, there are some prosthodontic principles that should be used. One principle to be followed is whether the prosthesis uses clasps or an attachment, the forces should be widely distributed to all available tissues. The denture base of tooth/tissue-supported removable partial dentures should be extended to cover the residual ridge within the limitation of functional muscle movements. The teeth and denture supporting area should both be used to provide support, bracing, retention direct-indirect retention,

and stability. If one of these tissues is incapable of providing these functions, other restorations (e.g., complete dentures or a restoration using dental implants) should be considered. It is important that the removable partial denture framework can be properly related to the teeth and the denture base to the framework. This principle is satisfied if the entire framework is rigid and the framework contacts three or more teeth, preferably widely separated and with rest seat preparations. Contact of the framework with only two abutment teeth is inadequate if there is no other way to positively relate the framework to the teeth. If a resilient attachment is used, there must be additional contact between the framework and the abutment teeth other than the attachments themselves. There must be way to deactivate the attachment, making the prosthesis rigid and thus allowing evaluation of the relationship between the base and the residual ridge

Rests:

Mesial occlusal rest concept:

The clasp design containing

1) a mesial occlusal rest
2) horizontal reciprocal arm
3) a retentive arm engaging a distobuccal undercut is another widely advocated approach.

When occlusal load is applied to the base, the retentive terminal tends to move away from or to withdraw its contact with tooth surface.

A further advantage of this is that depression of the base does not exert a distal stress (pump handle effect) on the abutment teeth but rather a mesial one that is resisted by not only by abutment, also by natural teeth mesial to abutment.

Disadvantage of this concept is rigid horizontal reciprocal arm associated with this design arrangement may develop a medio-lateral stress to abutment tooth. It must be borne in mind that reciprocal arm is positioned on suprabulge and will move in gingival direction when the occlusal load is applied to the base. This rigid reciprocal arm exerts a buccal stress as it is forced downward onto the suprabulge.

RPI, RPA concept:

RPI clasp is based on mesial rest concept and is given by Kratochvil's. This

clasp assembly consists of mesial rest with minor connector placed on the mesio-lingual embrasure, but not contacting the adjacent tooth. A distal guiding plane extending from marginal ridge to junction of middle and gingival third and an 'I' Bar. In RPI, system most distal rests are placed on mesial aspect of abutment teeth for following reasons.

1. Anterior placement of the rest fulcrum helps verticalize the forces of occlusion on bearing mucosa under denture base extension.
2. Mesial rest directs tipping forces on the abutment mesially and tends to move the abutment tooth into firm contact with the support of mesial teeth.

Proximal plates:
Parallel guide planes are prepared on all proximal tooth surfaces adjacent to edentulous spaces. In Kratochvil's original design, proximal plate covers the guide plane from marginal ridge to the tooth tissue junction and extends onto the attached gingival for 2mm. This configuration serves many functions. It

1. Provides horizontal stability.
2. Reunites and stabilizes the arch.
3. Increases retention because of parallelism and because dislodgement is limited to the path of insertion.
4. Protects the tooth tissue junction by preventing food impaction and because of metal coverage in this area.
5. Provides reciprocation
6. Distributes the occlusal forces throughout the arch.

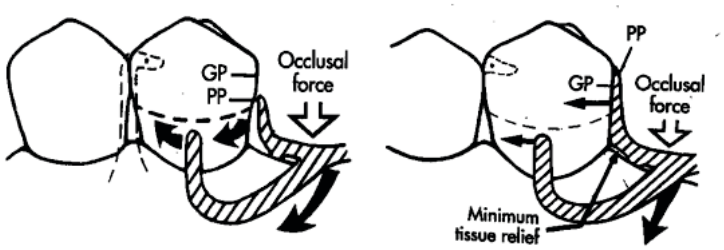
Direct Retention – I Bar:
The position of 'I' Bar in relation to height of contour is essential to this design because proper positioning allows the tip to move passively in to the mesial embrasure space when the extension base receives occlusal loading.

In agreement with Kratochvil's basic design, Krol developed a modification that studiously avoids tooth preparation. The stated emphasis in Krol's system is stress control with minimal tooth coverage and minimal gingival coverage.

The clasp system includes the three elements of Kratochvil's system:

mesial rest, proximal plate, and 'I' Bar. Each element has undergone significant change to meet Krol's criteria. Rest preparations are less extensive in RPI system. The mesial rest extends only into the triangular fossa, even in molar preparations and canine rests are often circular concave depressions prepared in the mesial marginal ridge.

The proximal plate makes greatest departure from Kratochvil's design. The prepared guide plane is 2-3mm high occluso-gingivally and the proximal plate contacts only 1mm of gingival portion of guide plane. Relief as provided at the tooth tissue junction to allow proximal plate to disengage into the proximal undercut under occlusalloading. Modification in I Bar configuration and placement are needed to compensate for the loss of tooth contact on the proximal plate. The I Bar terminus is pod-shaped to allow more tooth contact and placement tends toward the mesial embrasure space to achieve more efficiently reciprocation from the diminutive proximal plate (as shown in fig 23)



Kratochvil Design of RPI Krol Modification of RPI

Fig:23 Approach for Application of RPI system

Occlusal force on extension base disengages the retentive tip into mesial embrasure.

The stated purpose of reducing the proximal plate is to improve gingival health by opening up embrasure spaces as much as possible. Tipped abutments and tissue impingement are treated by further modification of RPI called RPA. When Akers clasp arm is used, careful attention is paid to relieve all undercuts except at the retentive tip.

Guiding planes

Guiding planes are important in the effort to maintain the integrity and

health of supporting tissues. Properly positioned and prepared guiding planes may reduce torquing forces directed to the abutment teeth. Guiding planes allow the patient to insert and remove the prosthesis along a predictable, repeatable path of insertion and withdrawal, minimizing the potential for soft tissue injury that may occur during the placement and removal of the prosthesis. The preparation of guiding plane length for all tooth-supported prosthesis may extend up to one-half the length of the proximal surfaces of the abutment teeth. This is not so for abutments supporting the distal extension prosthesis. In this situation, short proximal guiding planes are desirable in conjunction with a mesially placed rest. A well-positioned RPI clasp allows some degree of rotation of the clasp assembly over the abutment tooth. However, stress-breaking ability alone is not enough to ensure the health of supporting tissues, nor will any precision or semi precision attachment accomplish this goal by itself. Stress breaking must be accomplished by a properly extended and adapted denture base and a harmonious occlusion.

MAJOR CONNECTOR

Major connector must be sufficiently rigid so that forces applied to any one portion of the denture may be optimally distributed over the entire supporting area.

MAXILLARY MAJOR CONNECTORS

1) Anterior –Posterior Palatal Strap
2) Palatal plate-type connector
3) Single palatal strap
4) U-shaped palatal connector (Anterior Palatal Strap)
5) Anterior-posterior palatal bar
6) Posterior palatal bar

ANTERIOR-POSTERIOR TYPE SYNONYMS: A-P TYPE, RINGSHAPED, DOUGHNUT-SHAPED, CLOSED HORSESHOE, CIRCULAR (as shown in fig 24)

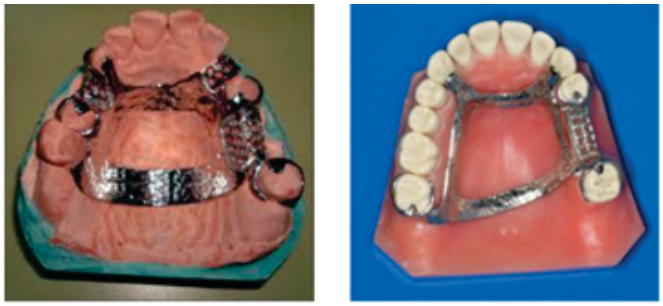


Fig: 24 Antero-posterior Type Major connector

Indications:

1. Class III or Class III mod 1 partially edentulous arch with a long span edentulous space.
2. Class I or class II partially edentulous arch where adequate support, retention, bracing, and direct-indirect retention may be obtained from contact of the denture base with the ridge and the contact of the framework with the palate.
3. An inoperable palatal torus.
4. A RPD replacing anterior teeth.

Contraindications:

1. Where the palatal opening will be less than 15 mm antero-posteriorly or mediolaterally.
2. Where support, retention, bracing, and direct-indirect retention from the palate is required.
3. Where a major connector with a simpler design may be used.

Advantages:

1. Covers a minimum of palatal tissues.

Disadvantages:

1. Very complex design.
2. A lot of metal-tissue edges.
3. The posterior palatal bar or strap frequently does not fit the palate closely.
4. The anterior border is frequently located in the rugae.
5. The posterior border is frequently located in the hamular notch-vibrating line area.

PALATAL PLATE SYNONYMS: BROAD PALATIAL STRAP OR PLATE, POSTERIOR PALATAL STRAP OR PLATE, BROAD PALATAL MAJOR CONNECTOR(as shown in fig 25)

Fig:25 Broad Palatal Major Connector

Indications:
A Class I or Class II partially edentulous arch.

Contraindications:
1. A tooth supported edentulous space.
2. A palatal torus.

Advantages:
1. Support is provided by contact of the major connector with the denture bearing foundation of the palate.
2. Fairly simple design.

Disadvantages:
1. Covers a considerable portion of the palate.
   DESIGN I presents the following difficulties

a) The hamular notch vibrating line area must be located on the master cast.
b) Difficult to adjust the metal-tissue contact.
c) Difficult to reline the metal portion of the palatal contact.

DESIGN II presents the following difficulty:
a) Difficult to blend the thickness of the metal (1 mm)- plastic (3 mm) junction.
b) The anterior border is frequently located in the rugae.

U-SHAPED SYNONYMS: ANTERIOR PALATAL STRAP, HORSESHOE, OPEN RING, OPEN DOUGHNUT. (as shown in fig 26)

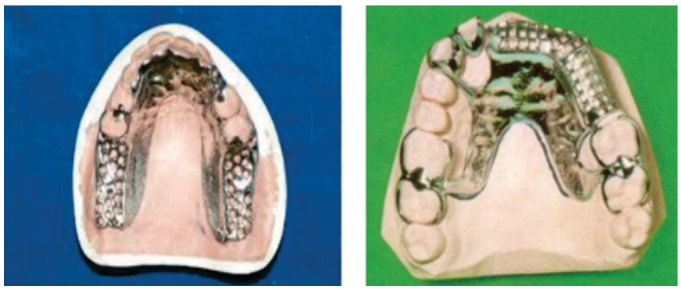


Fig: 26 U Shaped Major Connector

1. A Class IV partially edentulous arch.
2. A Class III or Class III mod 1 partially edentulous arch with an anterior edentulous space, where cross-arch force distribution is not important.
3. A partially edentulous arch with an inoperable palatal torus.

Contraindications:

1. Where support, retention, bracing, and direct-indirect retention from the palate is necessary.
2. Where cross-arch force distribution is necessary.

Advantages:

1. Minimal coverage of the palate.
2. Fairly simple design.
3. Fewer metal-tooth or tissue edges than the A-P design

Disadvantages:

1. Not as rigid as other maxillary major connectors.
2. Rigidity may be increased by having the metal in the vertical and horizontal planes and is probably adequate, particularly with cast chromium.

SINGLE PALATAL STRAP

Indications

1- Posterior bilateral edentulous spaces of short span in a tooth-supported restoration.

2- It may also be used in tooth-supported unilateral edentulous situations with provision for cross-arch attachment by extracoronal retainers.

Contraindications

1- Tooth-tissue supported removable partial denture.
2- Presence of palatal tori.
3- Extremely long edentulous span. Anteroposterior major connector would be better

ADVANTAGES

1- Very simple design.
2- Very few metal-tissue edges.

DISADVANTAGES

It covers a considerable portion of the palate

ANTERIO-POSTERIOR PALATAL STRAP

It is a rigid palatal major connector. The anterior and posterior palatal strap combination may be used in almost any maxillary partial denture design. The strength of this major connector design lies in the fact that the anterior and posterior components are joined together by longitudinal connectors on either side, forming a square or rectangular frame.

Indication

(1) In Class I and II arches in which excellent abutment and residual ridge support exists, and direct retention can be made adequate without the need for indirect retention from palate (palatal plate).
(2) Long edentulous spans in Class II mod. 1 arches.
(3) In Class IV arches in which anterior teeth must be replaced with a removable partial denture.
(4) Inoperable palatal tori that do not extend posteriorly to the junction of the hard and soft palates.

Contraindication

1- When can use simple major connector.
2- When there is large inoperable palatal torus that extends posteriorly to the soft palate, so broad U- shaped major connector may be considered.

Advantages

The double-strap type of major connector provides the maximum rigidity without bulk. It covers minimum of palatal tissues than full palatal coverage.

Disadvantages

1- Very complex design.
2- A lot of metal-tissue edges.
3- The posterior palatal bar or strap frequently does not fit the palate closely.
4- The anterior border is frequently located in the rugae.

Single palatal bar: (as shown in fig 27)

Fig:27 Single palatal bar

- It is a bar running across the palate which is narrow,half oval in cross section with it's thickest point in the centre.
- Gentle curved and should not form an angle

Indications: ClassIII (short span)application

Advantages:
Used primarily in interim application

Disadvantages:
Bulky causes discomfort to the patient
Narrow antero-posterior width
Little support from palate

When designing maxillary bilateral distal-extension prosthesis, consider that as much retention is developed by the relationship between both the major connector and denture base to the underlying tissues as by the direct retainer. When only the six anterior maxillary teeth remain, consider the extension of the prosthesis as for a complete denture and extend the borders and the base coverage accordingly. Thus the forces are distributed between the mucoperiosteum, bone, and the abutment teeth

MANDIBULAR MAJOR CONNECTORS

Six types of mandibular major connectors are:

1- Lingual bar.
2- Linguoplate (lingual plate).
3- Sublingual bar.
4- Lingual bar with cingulum bar (double bar).
5- Cingulumbar.
6- Labial bar and buccal bar.

Lingual bar &lingual plate major connectors (as shown in fig 28)

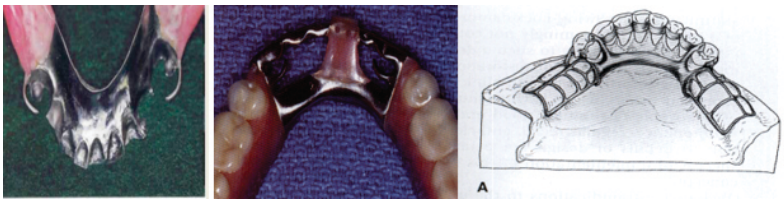


Fig:28 Lingual bar and Lingual plate

are used in the majority of removable partial denture applications. Double lingual bar and labial bar major connectors are used for special applications in which lingual bars and lingual plates are contraindicated

Lingual bar: Is the most frequently used mandibular major connector, because of its simplicity in design and construction.

Indication: It is the first choice major connector, should be used whenever the functional depth from free gingival margin to the lingual vestibule equal or exceed 8mm.

Advantages:

1. The simplest mandibular major connector with highest patient acceptance.
2. It does not cover the teeth or the gingival tissues

Disadvantages:

If it is not properly designed it may not be rigid.

Lingual plate:

Half –pear shaped lingual bar with a thin ,solid piece of metal extending

from its superior border. This thin projection of metal is carried onto the lingual surfaces of the teeth and presents a scalloped appearance. The inferior border of a lingual plate should be positioned as low in the floor of the mouth as possible, but should not interfere with the functional movements of the tongue and soft tissues. The superior border of a lingual plate must be contoured to intimately contact the lingual surfaces of the teeth above the cingula.

Indications:
1-used when there is insufficient vertical space for a lingual bar(distance from free gingival margin to floor of the mouth less than 8mm)
2-when there is gingival recession,high muscle attachments or high frenum attachments on the lingual aspect of the mandibular arch .
3-when the remaining teeth have lost much of their periodontal support and require splinting. Lingual plate used to stabilize the remaining teeth and to distribute applied forces over the remaining teeth and soft tissue.
4-lingual tori is present.

Advantages
1. The most rigid mandibular major connector.
2. It gives indirect retention to the partial denture.
3. Deflect food from impacting on lingual tissues.
4. Provide resistance against horizontal or lateral forces.
5. Permits the replacement of lost teeth without remaking the partial denture.
6. Help in splinting and prevent upper-eruption of the anterior teeth

Disadvantages: In patient with poor oral hygiene,lingual plate extensive coverage may contribute to decalcification of enamel surfaces and irritation of the soft tissue in patients with poor oral hygiene.

Double- lingual bar with cingulum bar

Indications:
1. When indirect retention is required.
2. When periodontally affected teeth that require splinting are present.

Advantages:
1- provide indirect retention.
2- contribute to horizontal stabilization

3- no gingival margin coverage.

Disadvanges:-
1- Tongue annoyance
2- food impaction if the upper bar is not intimate contact with the teeth.

Cingulum bar (as shown in fig 29)

Fig:29 Cingulum bar

Indications
1- height of activated lingual frenum and floor of the mouth at the same level as marginal gingiva
2- inoperable tori or exostosis at the same level as the marginal gingiva
3- severly undercut lingual alveolus
4- considerable gingival recession.

Contraindication:
1- anterior teeth severely tilted to the lingual
2- diastema and open cervical embrasures where the metal will show.

Advantages:
1- can be used where lingual bar and lingual plate cannot be used
2- does not transverse the marginal gingiva or overly the lingual alveolus.
3- easy to add prosthetic teeth to framework.

Disadvantages:- Must be bulky to have sufficient rigidity and thus may be objectionable to the patient.

Labial bar (as shown in fig 30)

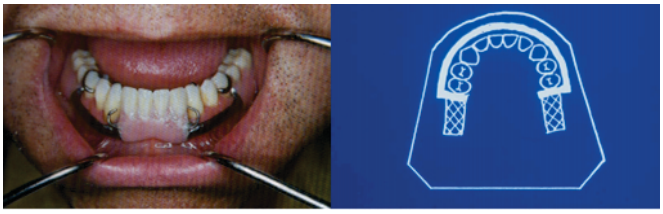


Fig:30 Labial Bar

Indications:

1. When the mandibular teeth are so severely inclined lingually as to prevent the use of lingual major connector.
2. When large lingual tori exist and their removal is contraindicated.

Advantages:

1- It solved the problem of lingually inclined teeth &avoid surgical intervention to remove large lingual tori

Disadvantages:-

1- lack of rigidity
2- least comfortable to patient.

PREVENTIVE PHILOSOPHY IN FIXED PROSTHODONTICS:

Preservation of tooth structure by designing fixed partial denture:

One of the basic tenets of restorative dentistry is to conserve as much tooth structure as possible consistent with the mechanical and esthetic principles of tooth preparation. This will reduce the harmful pulpal effects of various procedures and materials. The thickness of the remaining dentin has been shown to be inversely proportional to the pulpal response, and tooth preparations extending deeply towards pulp should be avoided. Dowden has stated that any damage to the odontoblastic processes will adversely affect the cell nucleus at the dentin pulp interface, no matter how far from the nucleus it occurs. Tooth structure is conserved by using the following guidelines.

Use of partial coverage rather than complete coverage restorations

1. Preparation of teeth with the minimum practical convergence angle between axial walls.
2. Preparation of the occlusal surface so that the reduction follows the anatomic planes to give uniform thickness in the restoration.
3. Preparation of the axial surfaces so tooth structure is removed

uniformly; if necessary teeth should be orthodontically repositioned.

4. Selection of conservative margin compatible with the other principles of tooth preparation.
5. Avoidance of unnecessary apical extension of preparation.(as shown in fig 31)

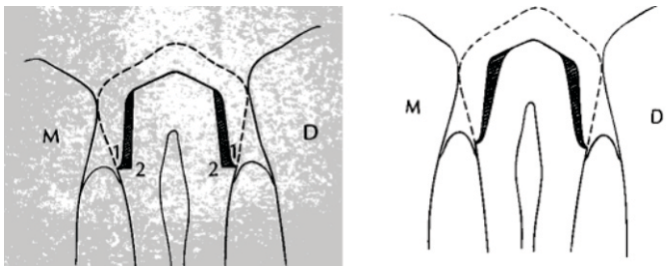


Fig:31 Standard preparation for Fixed partial dentures

Various partial retainers :

1) Posterior three quarter crown
2) Anterior three quarter crown
3) Pin modified three quarter crown
4) Reverse three fourth
5) Proximal half crown
6) 4/5th crown
7) 7/8th crown

Partial coverage restorations:

An extra coronal metal restoration that covers only part of the clinical crown is considered as partial coverage restoration (or) partial veneer crown. Whenever feasible, a partial – coverage restoration should be selected rather than a complete veneer because it preserves more of coronal tooth structure. It results in less pulpal and periodontal insult. The supragingival margin provides easy access for oral hygiene maintenance.

Resin Retained Fixed Partial Dentures: Rochette introduced the concept of bonding a metal retainer to enamel using adhesive resin. His application was to splint periodontally involved mandibular anterior teeth using a cast gold bar bonded to the lingual surfaces of the teeth. The cast metal splint described had perforations to provide mechanical interlocking between the cement and the metal. His introductory article made reference to modifying the technique for application as an Resin Bonded Fixed Partial Denture(RBFPD). Today, this type of design with

perforated retainers, can be used to facilitate retrievability when an RBFPD is used as a provisional restoration.

Livaditis proposed abutment preparation, including reduction of proximal and lingual surfaces to create a path of insertion, along with occlusal rest seat preparation to resist tissueward displacement of the retainer. These modifications enhanced the retention and resistance forms of the metal retainer to the tooth. Attention then turned to treatment of the retainer's fitting surface to increase the resin to metal bond strength. Livaditis and Thompson introduced the concept of electrolytically etching a non-precious metal to microscopically roughen the metal surface. Electrolytic etching works on the principle of selective dissolution of the most corrosion-sensitive phases of the metal. Mean tensile bond strengths of 27.3MPa for resin composite bonded to an electrolytically etched alloy were reported

Classification of Resin- Retained FPDs:

1. Cast perforated resin retained FPD (Rochette Bridge)
2. Etched cast resin retained FPD (Maryland Bridge)
3. Macroscopic mechanical retention resin retained FPDs (Virginia bridge).
4. Chemical bonding resin retained FPDs.

Designing:

The initial designs of etched cast retainers included an “interproximal wraparound” concept developed to resist occlusal forces and provide a broader area for binding. Enamel preparation consisted of creating occlusal clearance, placement of occlusal and cingulam rests, and lowering the lingual and proximal height of contours, thus creating proximal extensions. Its advantages include minimal removal of tooth structure and minimal potential for pulpal trauma. Supragingival margins of this prostheses permits easy hygiene maintenance.

Fiber Reinforced Composite Fixed Prostheses: Fiber reinforced fixed prostheses are an innovative alternative to traditional metal ceramic restorations. They should be considered for certain patients because they provide a conservative approach to replace missing teeth and overcome some of the drawbacks of conventional prostheses.The restoration consists of fiber reinforced composite substructure veneered with particulate composite material. It requires minimal removal of crown

structure and provides no nickel allergy due to lack of any metal substructure. It results in less wear of opposing tooth structure.

Prevention Of Iatrogenic Damage During Crown Preparation:

Adjacent teeth**:** Iatrogenic damage to the adjacent tooth is a common error in dentistry. Damaged proximal contact area is more conducive to dental caries. It can be prevented by placing metal matrix band around adjacent tooth. A preferred method to avoid damage is, leaving a thin lip of enamel by passing a tapered diamond through the contact area.

Soft tissues**:** Damage to the soft tissues of the tongue and cheeks can be prevented by careful retraction with an aspirator tip, mouth mirror, or a flanged saliva ejector. Great care must be exercised to protect the tongue when the lingual surfaces of the molars are prepared.

Pulp: There are number of factors, which can cause pulpal response, include extreme temperature, chemical irritation, or microorganisms particularly when they occur on freshly cut dentinal tubules. Prevention of pulpal damage necessitates selection of techniques and materials that will reduce the risk of damage. Tooth preparation must take in to consideration the morphology of the dental pulp chamber.

Air-water spray: Apparently, an air-water spray gives the greatest protection to the pulp. The reasoning is that there is a better dissipation of the frictional heat and less desiccation of the tooth tissue.

It is necessary to keep the pulp within +10° of 98.6° F. (normal body temperature) to prevent the pulp from undergoing necrosis. Studies have shown that an increase of 10° F. caused necrosis in 15 per cent of the pulps with an increase of 15° the incidence was 20 per cent; 20° F gave 60 per cent; and 30° F. resulted in 100 per cent loss.

Dry air-blast cooling:Literature reviewed suggests that a steady stream of air used as a coolant for ultraspeed low-torque cutting instruments is an effective and acceptable method of preventing thermal injury to the pulp, and its use is not contraindicated.

Caries: We are not always dealing with sound teeth for bridge abutments. Active caries will penetrate the dentin an average of 1.0 mm. every six months. Long before bacteria reach the pulp, their enzymes, toxins, and

organic acids span the remaining distance of the dentinal tubule. All carious dentin should be removed before placing the restoration that will serve as a foundation for a fixed prosthesis. An indirect pulp cap is not recommended, because its later failure is likely to jeopardize extensive prosthodontic treatment.

Direct pulp exposure: Calcium hydroxide has been recommended as a capping agent to stimulate reparative dentin since 1937. It causes a chemical cauterization of about 1.0 mm of pulp tissue. The by-products of the cauterized tissue are locked and prevented from permeating the vital tissue. The result is a minimum of inflammatory response. Regeneration starts at the junction of the mummified tissue. Unfortunately, the process is not always self-limiting, and occasionally the entire pulp will fill with reparative dentin preventing endodontic therapy. If it is improperly applied, it may form emboli in the pulp which stimulate reparative dentin in undesirable places.

Drying: Many of oralprocedures require that we dry the prepared abutment. This causes a response. Within 20 minutes after application of a two-minute air stream, there is a strong migration of odontoblasts.

Since dentin is a good insulator, the air blast may not significantly change the pulp temperature even though there is an extensive displacement of the odontoblasts. Vesicles have been observed in the pulp as a result of the air blast. The outward flow of odontoblasts may be caused by evaporation of fluid from the outer ends of the tubules.

Dehydration of dentin was seen by restorative materials. Silicate cements, zinc oxide eugenol cements, these are all hygroscopic. Resins undergo water sorption and have a steady dehydrating effect. These and similar materials might cause a centrifugal flow of fluid in the dentinal tubules which will result in aspiration of the odontoblasts. It might be well to use a protective varnish with temporary restorative materials.

Treatment of abutments after preparation: Corticosteroids have been recommended for the treatment of abutment teeth after preparation. There is a conflict in the literature as to the value of this procedure.

Reactions in the pulp caused by caries seem to persist no matter which corticosteroid solution is used: however, the pain may disappear. There is a

possibility that corticosteroids preserve chronic inflammation. In the long run, they may not be beneficial and certainly are not a substitute for endodontic treatment

Temporary protection: Because of the sensitivity of prepared teeth and the accumulation of plaque on the areas that are not self-cleansing, some type of temporary coverage is necessary to protect the pulp.

One of the methods for fabricating temporary restoration is direct method using auto polymerizing acrylic reins. The free monomer is toxic to the pulp and hence a protective varnish or calcium hydroxide lining should be applied before preceding the temporary fabrication.

Impressions:

An impression is an imprint or negative likeness

Ideal Requirements of cast restoration Impression

1. Exact duplication of the prepared tooth, adjacent tooth and tissues.
2. Enough uncut tooth surface beyond the preparation
3. location and configuration of the finish line
4. free of bubbles

Classification of Impression Material

1. Hydrocolloid impression material
   A) Irreversible B) Reversible
2. Elastomeric Impression Material
   a) Polysulphide
   b) Addition Silicone
   c) Condensation Silicone
   d) Polyether Dimethacrylate

Impression Technique

1. Reversible Hydrocolloid technique
2. Stock tray technique – Double mix or single mix
3. Custom tray technique
4. Double Arch technique
5. Copper Band technique
6. Matrix System

Comparison of Impression Materials:
These are compared on the basis of three characteristics – Wettablity – Viscosity – cost

Wettablity:
Greater the wettablity, less would be the contact angle – devoid of bubbles and easier to pour.

- Hydrophilic: Irreversible hydrocolloid (alginate), reversible hydrocolloid, and polyether
- Hydrophobic: Polysulfide, PVS materials.

Viscocity:
Increase with mixing time
Syringing impression is preffered over spatulating

Reversible Hydrocolloid :
- Widely used impression material for 70 years.
- Packed as a semi-solid gel in polyethylene tubes
- It is passed through three hydrocolloid conditioner tanks before inserting into patient mouth – Liquefying – Storage – Tempering
- Special tray (double- walled) is used through which cool tap water is circulated to complete the gelation process

Disadvantage –
- Imbibition ,
- Absorption ,
- Syneresis , water loss, if excessively dessicated

Steps for reversible hydrocolloid impression :
After the tooth preparation is done GTR is placed in the sulcus area RHC is liquiefied in solution conditioner and then placed in storage tank . The liquefied RHC cartridge loadedin the syringe GTR is removed and impression material from syringe is poured into sulcus. Now the quadrant is loaded with tempered RHC and placed over the prepared quadrant and allowed to cool for 10 min as the quadrant impression cools, full arch impression is made using tempered RHC opposite arch impression can be made with irreversible hydrocolloid (alginates)

Other modification :
Laminates technique - Use of reversible hydrocolloid for prepared section and then irreversible hydrocolloid for full arch

wet field technique - In this technique the tooth surfaces are purposely left wet and areas are usually flooded with warm water. The syringe material is introduced quickly, liberally and in bulk to cover occlusal/incisal areas only. While the syringe material is still liquid, tray material is seated, the hydraulic pressure of the viscous tray material forces the syringe material into areas to be restored.

Contraindicated in grooves, boxes, or isthmus.

Elastomeric Impression:
- Polysulphide
- Addition Silicone
- Condensation Silicone
- Polyether dimethacrylate

Custom Resin Trays :
Accurate impression –
Three or more unit interpreparation and cross arch discrepancies could have a significant impact on the fit of the restoration – custom tray reduces discrepancies to much extent.

Requirements of Custom tray:
- Rigid
- stops on the occlusal surfaces of the teeth to orient the tray properly when it is seated in the mouth
- Impression material should adhere firmly to tray – rubber adhesive is used.

Custom resin tray can be made up of either visible light cure (VLC) polymer or self cure polymer. Spacer wax applied over diagnostic cast and 2 to 3 mm beyond the necks of the teeth is neatly trimmed. Occlusal stops (3X3 mm) made over spacer wax in posterior and incisive region. Tin foil is adapted impregnating the surface of the tray during the exothermic polymerization of the resin. The edge of the tray should lightly touch the cast all around its periphery, including the retromolar areas, when the stops are fully seated. Acrylic is adapted over the spacer and cured for 30

sec then taken out of curing chamber to correct the slumping handle .Again it is placed for 30 sec and take out. Smoothen and finish it, remove spacer and tin foil and apply triad ABC (Air Barrier Coating used for curing air inhibited surfaces).Again place for curing for 2 min. Custom resin tray is an Autopolymer where monomer and polymer is mixed and waited till it is applicable. It is adapted over the foil with proper horizontal handle in the middle and a narrow ledge or "wing" on either side of it then left for polymerization till it gets harder and little warmer. Wax and tin foil are removed.

As it is an auto-polymer impression should be made only after 6 hours as polymerization shrinkage may cause discrepancies. In case, cast has to be poured immediately then impression can be made at least after 40 mins of polymer mixing with acceptable linear expansion. It shouldn't be stored in moisture as it gets distorted, the inner side of the tray is painted with adhesive

Dual-Arch Impressions :
Dual arch impression techniques utilize special stock impression trays of various designs. These trays are made of flexible plastic or mesh material placed across the occlusal surfaces of the teeth connecting their buccal and lingual flanges.

Indication :
- single tooth with intact adjacent and opposing teeth
- mutually protected Angle Class I occlusion
- 2 types short sidewalls or taller sidewalls.
- Where adequate GTR and moisture control is done.

Dual-Arch Impressions Technique:
Low-viscosity impression material is injected around the prepared tooth. While this is occurring, the dental assistant loads the high-viscosity material into the tray and the tray is inserted immediately .Minimal time must elapse between the completion of the syringing of the low-viscosity material around the prepared tooth and the introduction of the loaded tray. After the impression material is set, it is verified for accuracy then the die-stone is poured firstly on prepared teeth side then to opposite arch. After the cast is set, its articulated on Foster spring chrome articulator

Polysulfide:
Base paste – polysulfide polymer :mercaptan (-SH)
Filler : lithopone or titanium dioxide
Plasticizer : dibutyl phthalate

Accelerator: sulfur 0.5%

Catalyst (or accelerator) paste – lead dioxide radiopacity and chracterstic brown color

Retarder : oleic or stearic acid

Polysulfide : Maximum accuracy can be obtained, A polysulfide impression should be poured within approximately 1 hour of removal from the mouth or less. As it is hydrophobic in nature there shouldn't be moisture on the preparation when the impression is made.

Method :
The retraction cord is inserted and a large gauze pack is placed in the mouth .Two system paste i.e Regular base and light base the light base and heavy base is mixed on mixing pad in interval of 30 seconds. Light base is loaded in syringe and heavy base loaded on tray. Light base is syringed on tooth preparation after removal of GTR and light moistening. Subsequently heavy base loaded custom impression is loaded in the mouth.

Condensation Silicone :
Two paste system – base paste : A-Ω-hydroxyl-terminated polydimethylsiloxane and fillers – Catalyst Paste : organo-tin silicones

Method : Before the preparation a stock tray that fits the arch is selected .Tray adhesive applied on tray then two scoops of putty (base) are placed on the pad and6 drops of accelerator are added for each scoop of base .Mix on pad with spatula for few seconds and then knead in palm for 30 seconds .It should be free of streaks and rolled in cigar shape and placed in stock tray then covered with a polyethylene spacer and the tray is seated in the mouth .After initial set has occurred (about 2 minutes) spacer is peeled off and impresion is examined for error. If any extra impression material is there it is removed with sharp knife.

After the preparation anesthesia is given and GTR is placed into mouth 8 inches of the thin-wash silicone base are squeezed out onto the disposable mixing pad. One drop of accelerator is added per inch of base and mixed for 30 second ,one-third of the wash material is placed into the back end of the syringe to allow the material to set into the tray. Removal of GTR is done as gentle as possible. The syringe material is immediately injected into the sulcus and around prepared teeth the tray is seated slowly until it is firmly in place with no downward pressure for 6 minutes . As the impression is set, it is removed as quickly and in as straight a path as possible to prevent plastic deformation of the material then rinsed to remove blood and saliva, blown dry , and inspected and disinfected and poured and the opposing arch can be made with alginate

Polyvinyl Siloxane : Also known as Addition silicone or vinyl polysiloxane (VPS) or vinyl silicone i.e light body, medium body and heavy body 2 paste system

- base paste: polymethylhydrosiloxane, as well as divinylpolysiloxane and fillers
- Catalyst (or accelerator) paste: divinylpolysiloxane a platinum (catalyst) and palladium(H2 scavenger) salt and fillers.

No reaction by-products are formed as long as the correct proportions are taken and it is impurity free .Residual polymethylhydrosiloxane in the material can lead to a secondary reaction with each other or with moisture, to produce hydrogen gas,and pinpoint voids as seen in the gypsum casts poured soon after removal of the impression from the mouth.

It is hydrophobic in nature, if nonionic surfactant is added surfactant migrates toward the surface of the impression material and has its hydrophilic segment oriented toward the surface. Dry field for impression making is required. Sulfur contamination from natural latex gloves or vinyl gloves inhibits the setting of addition silicone.

Polyvinyl Siloxane is least affected by pouring delays or by second pours .It is still accurate, even when poured 1 week after removal from the mouth .Available as Single barreled or twin-barreled cartridge with either automixing and manual mixing.

Polyether:
Polyether impression materials are used for making impressions when producing dental restorations. Hydrophilic to provide accurate impressions in moist conditions, polyether impression materials come in various viscosities from lightweight/soft to heavyweight and have varying setting times. Dispensing techniques can be hand mix, syringe or machine mix to reduce waste and ensure accuracy. Features to look for when choosing polyether impression materials include biocompatibility, acceptable odor and taste, good detail reproduction, good tear strength, easy removal of impressions, sufficient working time with a short setting time, and a long shelf life.ex: Impregum F Polyether Impression Material Supplied in two pastes

Base paste:
Polyether
Filler

Catalyst paste:
Sulphonic acid ester(enhances further polymerization and crosslinking)

Inert oils(forms a paste)
When mixed the polymer and sulphonic acid ester react to form a stiff polyether rubber. Setting time occurs in about 6 minutes.

Light bodied material is available in syringe and tubes

Advantages:
- Complete control over working and setting time
- Curing time is relatively short
- Excellent physical,mechanical and clinical properties.

Disadvantages:
- Need for transparent trays
- If delay in placement material to be stored in dark place
- Difficult to cure remote areas
- Should not be used in patients allergic to methacrylates.

Heavy body polyether :
- Hydrophilic before, during and after the set for unsurpassed accuracy, even in the presence of moisture.

- Thixotropic: it flows smoothly under pressure in critical areas and remains fixed without pressure.
- Snap-setting characteristic provides for a rapid transition to the set phase while allowing sufficient working time. This ensures a precise-fitting final restoration without distortion.
- Polyether material characteristics guarantee impressions of the highest precision.

Cementing the completed restoration:

It has been suggested that final restorations be cemented with a temporary zinc oxide eugenol cement for several months so that reparative dentin will form and protect the pulp from the acid of the zinc phosphate cement. It is suggested that, because of the mild trauma caused by ultra speed, water-spray preparations have greatly decreased the formation of reparative dentin. Fifty days are required for the formation of reparative dentin after trauma. The formation seems to be so trivial with ultra speed preparation that it seems more practical to use a cavity liner and the permanent cement initially.

Penetration of phosphoric acid from zinc phosphate and silicophosphate cement causes a burn lesion and abscess formation in the pulp. Although the cavity varnishes are impermeable when painted on a glass slab, there is some permeability when used on the dentin. However, there seems to be sufficient protection to prevent irreversible changes.

When a complete crown is seated under pressure, the cement creates hydraulic pressure in every direction. If the crown is vented, much of the hydraulic pressure will be relieved.

Microleakage: Integrity of the margins of the restoration to the finish line within 50µ is essential to avoid cement dissolution and plaque accumulation. Cement, which is less soluble in oral environment, will prevent secondary caries of the abutment.

The response of the pulp to restorative procedures is cumulative. Each procedure adds to the response engendered by the previous one. The condition of the pulp before treatment is most significant. If the tooth is carious or has been restored previously, there is no way of accurately evaluating the pulp.

PROTECTION OF PERIDONTIUM:

One of the prime goals of restorative therapy is to establish a physiologic periodontal climate and facilitate the maintenance of periodontal health. Crown contour, margin placement, and pontic design all affect periodontal health.

CROWN CONTOUR

The contours for full and partial coverage restorations play a supportive role in establishing a favorable periodontal climate. Three prominent theories of crown contour have evolved: (1) gingival protection, (2) muscle actions, and (3) access for oral hygiene.

Gingival protection theory

The gingival protection theory advocates that contours of cast restorations be designed to protect the marginal gingiva from mechanical injury. This concept implies that under-contouring of the clinical crown will cause deflection of masticated food onto the gingival margin, forcing it into the sulcus, thus initiating gingivitis. This concept may have originated from the observation that interproximal food impaction occasionally can initiate acute inflammation. However, numerous studies have demonstrated a cause-and-effect relationship between plaque and gingivitis and in comparison, the interrelationship of periodontal disease and food impaction appears slight.

Muscle action theory

Morris was one of the first to question the rationale of the gingival protection theory. Few have suggested that over-contouring prevents the normal cleansing action of the musculature and allows food to stagnate in the overprotected sulcus.

Theory of access for oral hygiene

This theory is based on the concept that plaque is the prime etiologic factor in caries and gingivitis. Thus crown contour should facilitate plaque removal, not hinder it. When crowns were overcontoured experimentally, 64.3% of the test sites demonstrated an increase in periodontal inflammation. This was attributed to decreased access for oral hygiene.

The four guidelines to contouring crowns with emphasis on access for oral hygiene will be described.

1. Buccal and lingual contours–flat, not fat. Reduction or elimination of the infrabulge would reduce plaque retention.
2. Open embrasures: If plaque is a primary etiologic factor in gingivitis, then every effort should be made to allow easy access to the interproximal area for plaque control. Open embrasure spaces will allow for this easy access. An overcontoured embrasure will reduce the space intended for the gingival papilla. The result is a broadening of the contoured area, causing pressure and irritation on the papilla. This also inhibits effective oral hygiene.
3. Location of contact areas: Contacts should be high (directed incisally) and buccal in relation to the central fossa (except between maxillary first and second molars).
4. Furcation involvement: Furcations that have been exposed owing to loss of periodontal attachment should be ''fluted'' or ''barreled out''. The concept of fluting into molar furcations is based on the desire to eliminate ''plaque traps'' and facilitate plaque control.

MARGIN PLACEMENT (as shown in fig32)

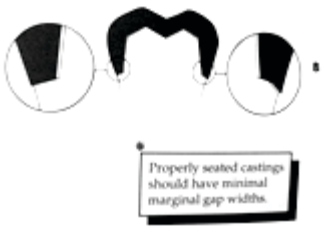


Fig: 32 Marginal placement

Plaque accumulation, inflammation, and gingivitis are reported to occur more frequently in teeth with subgingival crown margins than in those with supragingival margins. Oral hygiene instructions do not seem to alter this pattern.

Based on the findings of research, subgingival margins should be avoided except for the following specific situations: (1) esthetic demands, (2) caries removal, (3) subgingival tooth fracture, (4) to cover existing subgingival restorations, (5) to gain needed crown length, and (6) to provide a more favorable crown contour (that is, furcation involvement).

PONTIC DESIGN : The design of pontics for fixed partial dentures has been clouded by empirical judgment. The so-called ''sanitary pontic'' is not new to dentistry. The ''bullet-shaped'' pontic has been advocated by some authors as a desirable design to reduce food accumulation. Nearly all authors agree that the ''ridge-lap'' pontic is undesirable from the point of view of tissue health.

Stein's classic article on pontic design was largely responsible for a change in philosophy from a ''sanitary'' or ''bullet-shaped'' design to what is now commonly called a ''modified ridge-lap'' design. The modified ridge-lap design in the posterior region and the ridge-lap facing design in the anterior region offer minimal tissue contact, acceptable cosmetic value, proper cheek support, and accessibility for adequate oral hygiene. It has now been established that the design of the pontic may be the most important factor in preventing inflammatory reactions, not the material used in the pontic.

In addition to properly designing the undersurface of pontics, it is imperative to open embrasure spaces adjacent to abutments to allow room for interproximal tissue and access for oral hygiene. The occlusal surface should not be narrowed arbitrarily since this may create a food impaction and/or plaque retention situation similar to that of mal-posed teeth. The embrasure space between two adjacent pontics usually is closed to provide added strength, reduce food and plaque retention, and facilitate oral hygiene procedures under pontic areas

Basic guidelines for the access-for-oral-hygiene theory of crown contour, margin placement, and pontic design can be applied to nearly all fixed restorative procedures. These guidelines apply to full porcelain coverage restorations precision attachments, and coping reconstructions. Occasionally tooth preparations must be modified to allow for the added bulk needed for attachments, occlusal porcelain, and copings. If proper tooth reduction is achieved, physiologic crown contours can be developed easily, regardless of the prosthesis being used.

RATIONALE FOR DENTAL IMPLANTS:

The use of dental implants to provide support for prostheses offers a multitude of advantages compared with the use of removable prostheses or a fixed partial denture using natural teeth as an abutment.

A primary reason to consider dental implants to replace missing teeth is the maintenance of alveolar bone. The dental implant is placed in to the alveolar bone (as shown in fig 33)

The dental implant placed in to the bone serves not only as an anchor for the prosthetic device, but also as one of the better preventive maintenance procedures in dentistry. There is increase in bony trabeculae and density when the dental implant is inserted and functioning. An endosteal implant can maintain bone width and height as long as the implant remains healthy. As with the tooth, peri implant bone loss may be measured in lengths of a millimeter and may represent more than a twenty-fold decrease in lost structure compared with the resorption that occurs with the removable prosthesis.

The receptors in the periodontal membrane of the natural teeth help determine its occlusal position. Although endosteal implants do not have periodontal membrane, they provide greater awareness than complete dentures. The decrease in horizontal forces that are applied to implant restorations improve the local parameters and help preserve the underlying soft tissues and hard tissues. In the partially edentulous patient, independent tooth replacement with implants may preserve intact adjacent natural teeth as abutments, further limiting complications such as decay or porcelain fracture and poor esthetics, which are most common causes of fixed prosthesis failure. The masticatory performance of implant-supported prosthesis is better than any conventional removable prosthesis. The current trend to expand the use of implant dentistry will continue until every restorative practice uses this modality for the abutment support of fixed and removable prostheses.

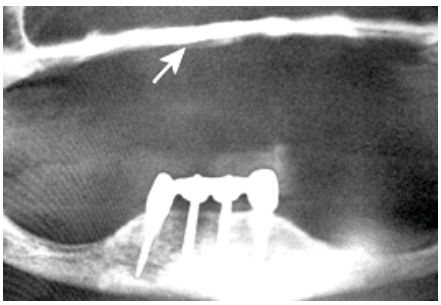


Fig:33 Radiographic image showing Dental implants placed in alveolar bone

General Clinical Recommendations for Loading Protocols

Conventional implant loading is predictable in all clinical situations and is particularly recommended in the presence of treatment modifiers such as poor primary implant stability, substantial bone augmentation, implants of reduced dimensions, and compromised host conditions.

Immediate implant placement for preservation of bone:

Early implantation may preserve the alveolar anatomy, and the placement of a fixture in a fresh extraction socket helps to maintain the bony crest.(as shown in fig 34)

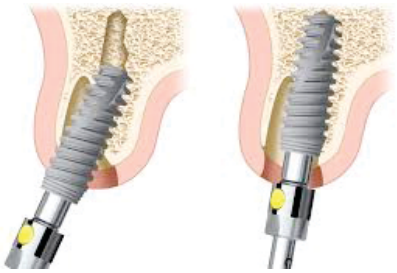


Fig:34 Placement of Implant in socket

Although a number of clinical studies exist, no histological reports show the outcome of implantation in fresh extraction sockets without the use of membranes in humans compared to implants placed in mature bone.

Bone Grafting and Guided Bone Regeneration for Immediate Dental Implants :

All implants were clinically osseointegrated at the 6-month re-entry surgery. Although some variation were evident, evaluation of healing to determine patterns of remodeling in relation to the preexisting bone anatomy showed complete fill of most of the socket. Bone loss at the most coronal alveolar crest and bone apposition at the most apical socket crest had a tendency to level the socket crest around the implants. The healing patterns of bone defects resembled those seen around periodontally involved teeth with vertical defects. Infrabony defects generally filled from the apical areas and narrow defects filled completely. As the gap between the socket wall and the implant become wider, bone fill was less likely to be complete, even when using a GTR technique without DFDBA (as shown in fig 35)

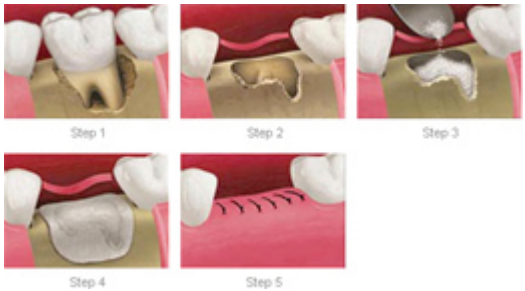


Fig :35 GTR Technique

Step 1:showing periodontal defects
Step 2:showing defects following tooth extraction
Step3:showing placement of bone graft
Step4:showing bone graft with barrier membrane is placed over the defect
Step 5:showing placement of sutures

Single Implant Prosthesis:

The single, anterior tooth implant is now an accepted and a highly predictable means of tooth replacement.

The occlusion required for the single tooth replacement is similar, but not identical, to the natural dentition. In centric occlusion, the implant supported crown should have a clearance of **30 m.** The clearance is important since the natural teeth can be intruded in their sockets under heavy loads whereas the implant retained prosthesis will not intrude. Failure to build in this appropriate occlusal clearance would expose the implant retained fixed prosthesis to excessive forces under heavy loading conditions.

Multiple Implant Prosthesis:

Implant dentistry provides different treatment options for the completely edentulous arch by providing multiple abudment sites for support of the prosthesis that enhances its performance. Various treatment options are available for the complete denture patient, Fixed implant supported prosthesis, Cement- retained prosthesis, Screw–retained prosthesis, Implant over-dentures, Hybrid prosthesis.

A proper pre-implant surgery evaluation is an essential step in the treatment planning process. It helps the clinician to decide on the

prosthesis and also decide upon the location, dimensions, and type of implants, based upon the prosthetic restoration to achieve the best esthetic and functional outcome. A step by step procedure in the pre-implant evaluation,

- Mounted casts and arrangement of teeth for try-in .
- Selection of the prosthesis type
- Location and number of the implants
- Fabrication of radiographic template
- Fabrication of surgical template
- Selection of the implant size and type
- Fabrication of provisional restoration.

Implant location:
For maxillary arch: Implant sites were located for ovoid arch as two implants in the incisor,two in the canine and two in the molar region.(as shown in fig 36)

Fig: 36 Implant placed in incisor,canine and molar region

For mandibular arch: Implant positions were two first molars ,two canines ,secondary implants in second molar and tertiary implant in the first premolar position.

An acrylic resin template impregnated with 5mm balls was used which provides information regarding the bone height and proximity to anatomical structures and pre-determine the position of osteotomy site in both bucco-lingual and mesio-distal dimensions.

Multiple Implant placement
Implants were placed following:

Standard protocol
Routine second stage surgery
Implant level impressions
Abutment connections
Provisional restorations

Preventive Implant Therapy

Preventive dentistry is mainly concerned with caries and periodontal disease and little, or no attention is paid to the prevention of alveolar bone loss. Preventive implantology is concerned with the preservation of the alveolar ridge of the (edentulous) jaw. After tooth extraction, the atrophy of edentulous lower jaws can be prevented or delayed by using implants supporting an over denture or a fixed mandibular prosthesis. Studies have shown that mandibular ridge shows a slower resorption pattern when it is loaded by implants supported prosthesis rather than a conventional mucosa supported dentures.Kalk *et al*. proposed the resorption stages of the residual ridges which are used in preventive implantology.

preventive stage I

Anatomic situation after tooth extraction. Further resorption can be prevented by implantation of the bone substituents .e.g.anresorbable hydroxyl appetite. .

Preventive stage II

After the initial resorption has occurred. In this case, further resorption can be prevented by placing cylindrical endosteal implants to maintain adequate width and height

Preventive stage III

Knife edged ridge. Bone removal is necessary for implant placement.

Preventive stage IV

Severe resorption of the alveolar ridge has taken place. Only basal bone is present. Implants are placed directly into the basal bone to prevent total loss of function of the arches.

Endosteal and subperiosteal are the two main types of dental implants available today. These two types are considered safe and effective according to the American Dental Association.

ENDOSTEAL IMPLANTS

Endosteal, which means “in the bone,” is the type of dental implant that is most commonly used. It is further categorized into different types according to the kind of accessories used. Blades, cylinders, and screws are placed into the patient's jawbone through surgery. A single implant has the capacity to hold at least one prosthetic tooth, but there are cases where an implant can hold two or more prosthetic teeth. Not all individuals qualify for this type of dental implant so getting a dental consultation is necessary. Generally, individuals who have dentures or bridges are good candidates for endosteal implants when the other options have been exhausted.

To provide more comfort and convenience to patients with fixed partial bridgework or removable dentures, there are endosteal implants that use custom-designed titanium metal frame that is of cast surgical-grade quality. The implants used are coated with a special kind of synthetic substitute for bone. It is called HA or hydroxyapatite, which comprises up to 98% natural bone. This coating makes the jaw believe that the implant is also a natural bone allowing the formation of a biochemical bond that ensures a secure hold of the implant.

SUBPERIOSTEAL IMPLANTS

Subperiosteal, which means “on the bone,” involves the use of metal frames that are fitted or placed onto the jawbone that is just right below the tissues of the gum. The post of the metal frame is in a protruding position through the gum to effectively hold the prosthesis that will be fitted too. After the procedure, the gums are expected to heal to completely recognize the success of the implant. When the gum is healed, the metal frame becomes totally fixed to the patient's jawbone. Then, the artificial tooth is mounted on the post; it follows the same procedure as an endosteal implant.

The framework used for subperiosteal implant is composed of cobalt, chrome, and molybdenum or surgical vitallium. There are also custom subperiosteal implants, which make every implant unique. The condition of the patient hugely affects this uniqueness or difference from other implants. The implant is custom-designed and fabricated using a model generated from a CT scan or a direct impression of the bone.

One of the situations that use sub-periosteal implant is when a patient has

lost most or all his posterior teeth. Another situation is when a patient has inadequate bone height, which does not allow endosteal implants.

Treatment alternatives for the edentulous arch include:
(1) Fixed-detachable prostheses
(2) conventional implant-supportedfixed partial dentures
(3) implant-retained overdentures, and
(4) implant- supported overdentures.

ALL ON FOUR IMPLANTSCONCEPT :
In some cases of the completely edentulous patients, implant supported prosthesis treatment is almost impossible without complex techniques such as nerve transposition and grafting in the posterior maxilla and mandible. A solution for such situations is theAll-on-4 concept. This method advocates tilting distal implants in edentulous arches which enables us in the placement of longer implants, improved prosthetic support with shorter cantilever arm, improved inter implant distance and improved anchorage in the bone . The “All-on-4 “treatment concept was developed by Paulo Malo with straight and angled multi-unit abutments, to provide edentulous patients with an immediately loaded full arch restoration with only four implants(as shown in fig 36).Two placed vertically in the anterior region and two placed upto an angle of 45degree in the posterior region. When used in the mandible, tilting of posterior implants makes it possible to achieve good bone anchorage without interfering with mental foramina in severely resorbed maxillae, tilted implants are an alternative to sinus floor augmentation.

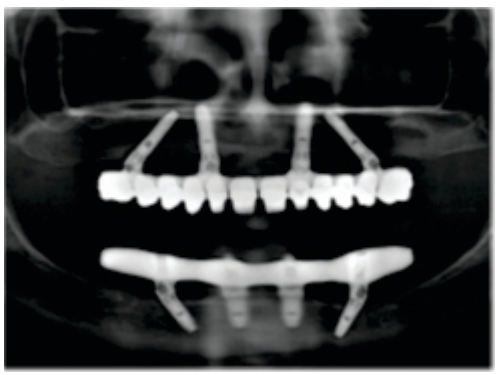


Fig:36 All on four implant prosthesis radiographic image

General considerations

To achieve primary implant stability (35 to 45 Ncminsertiontorque).
Indicated with a minimum bone width of 5mm and minimumbone height of10mm from canine to canine in maxilla and 8mmin mandible.
If angulation is 30 degree or more , the tilts can be splinted.
For tilted posterior implants, the distal screw access holes should belocated at the occlusal face of the first molar, the second premolar,or the first premolar.

Surgical Procedure

Implants in the maxilla are placed with two distal implants in the posterior region which are tilted anterior to the maxillary antrum while in the mandible implants are positioned anterior to the mental foramen. They should be inserted at an angulation of 30-45 degree. The use of the All-on-4 surgical guide assists in ensuring the placement of the implants with correct positioning, angulation and emergence. The guide is placed into a 2mm osteotomy that is made in the midline position of the maxilla or mandible and the titanium band is contoured to follow the arc of the opposing arch. The guide also assists in retracting the tongue in mandibular cases. The vertical lines on the guide are used as a reference for drilling at the correct angulation, which should not be greater than 45degree. The other guides that can be used for implant placement are Template, Angulated pins and Denture .Straight 17degree multiunit abutments and 30degree angulated abutments with different collar heights are placed onto the implants. These are used to achieve the correct access allowing relative parallelism and so that the rigid prosthesis can be seated passively.

Advantages of the All-on-4 concept

- Angled posterior implants avoid anatomical structures
- Angled posterior implants allow longer implants anchored in better quality bone
- Reduces posterior cantilever
- Eliminates bone grafts in the endentulous maxilla and mandible in majority of cases
- High success rates
- Implants well-spaced, good biomechanics, easier to clean
- Immediate function and aesthetics
- Final restoration can be fixed or removable
- Reduced cost due to less number of implants and avoidance of grafting

in the majority of cases.

Limitations

- Good general health and acceptable oral hygiene;
- Sufficient bone for 4 implants of at least 10mm in length; and
- Implants attain sufficient stability for immediate function.

Disadvantages

- Free hand arbitrary surgical placement of implant is not always possible as implant placement is completely prosthetically driven.
- Length of cantilever in the prosthesis cannot be extended beyond the limit.
- It is very technique sensitive and requires elaborate pre-surgical preparation such as CAD/CAM, surgical splint.
- Length of cantilever in the prosthesis cannot be extended beyond the limit.

Occlusal scheme for All-on-Four

Simultaneous bilateral point contacts on canine and posterior teeth and grazing contacts on incisors. In lateral movements, canine guidance opposing natural dentition, group function opposing posterior implant supported bridge with flat linear pathways and minimum vertical super imposition[97]. If the implant supported prosthesis is opposed to removal, complete denture orimplant supported over denture or a distal extension cast partial denture leave the most distal tooth slightly out of occlusion andin excursive movements seek one or more balancing contacts, planning greater antero-posterior space at the anterior teeth. The occlusal pattern should have relatively flat cusps i.e. the inclination of the cuspal planes should be less than the inclinations of the condylar path.

Since the teeth of the distal cantilever are less heavily loaded, the guiding surfaces of the incisors and canines can be expected to undergo increasing abrasions with time, therefore eliminate premature or non working side contacts on the distal cantilever.

ZYGOMA IMPLANTS (as shown in fig 37)

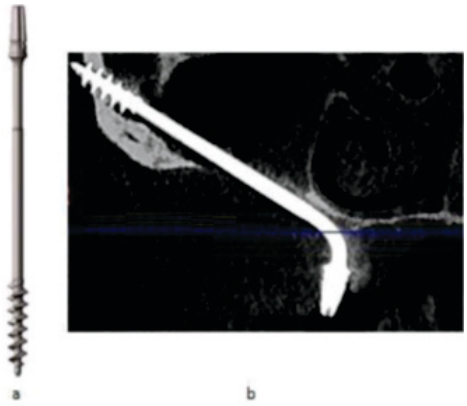


Fig:37 ZYGOMA IMPLANT

a. Zygoma implant
b. Zygoma implant placed radiographic view

The zygoma implant has been used as an alternative treatment for the severely resorbed maxilla. Efforts have been made to pursue alternatives to grafting procedures. The pterygomaxillary suture has been identified as an alternative site for implant placement . Others have suggested the use of tilted and/or short implants to avoid the need for sinus lift procedures .During the last two decades, the zygoma implant has proven to be an effective option in the management of the atrophic edentulous maxilla, as well as for maxillectomy defects. Branemark has introduced zygoma implant the prosthetic rehabilitation of patients with extensive defects of the maxilla caused by tumor resections, trauma and congenital defect .The bone of the zygomatic arch was used for anchorage of a long implant, which, together with conventional implants, could be used as an anchor for prostheses and/or obturators. The technique has enabled sufficient rehabilitation of these patients, providing restored function and improved esthetics, and has given many patients back a normal social life. The use of multiple zygomatic implants (e.g. two to three in each side) to support a prosthesis was suggested by Bothur et al.

Indications, contraindications and presurgical evaluation:
Indication :

Zygomatic implants was expanded to completely edentulous patients with severe maxillary atrophy. Since then, the main indication for zygomatic implants – posterior maxillary support in patients who are

completely edentulous with significant sinus pneumatization and severe posterior alveolar ridge resorption has remained unchanged. For the most common indication, the zygomatic implants are combined with two to four anterior maxillary axial implants.

Contraindications :
Zygomatic implants are contraindicated in acute sinus infection, maxillary or zygoma pathology and patients unable toundergo implant surgery because of underlying un- controlled or malignant systemic disease. Relative contraindications include chronic infectious sinusitis, the use of bisphosphonates and smoking more than 20 cigarettes a day. Any pathology of the maxillary Coronal image of a presurgical cone beam computed tomography scan shows bilateral occupation of both maxillary and ethmoidal sinuses.

The osteomeatal complex is closed on both sides. Functional endoscopic sinus surgery was prescribed prior to zygomatic surgery. Aparicio et al. suggested that sinus should preferably be treated before placement of the zygomatic implant.

Presurgical Evaluation:
Once the clinical examination is complete, radiographic examination allows for further appropriate treatment planning of the zygomatic implant Computed tomography is crucial for evaluation of the zygomatic implant site and the sinus status, as well as for the implant path. The amount of bone in the zygomatic arch and in the residual alveolar crest has to be explored. The angulation, expected emergence site and the relationship of the implant body to the maxillary sinus and the lateral wall are also considered. With the original technique, the path of the zygomatic implant was inside the maxillary sinus. The emergence of the head of the implant in the alveolar crest (typically in the palatal aspect of the second premolar region) is dependent on the spatial relationship of the zygomatic bone, the maxillary sinus and the alveolar crest. As discussed later, a new technique that includes the possibility of extra-sinus passage of the implant has been introduced, with promising results.

The maxilla can be divided into three zones: zone 1, the premaxilla;zone 2, the premolar area; and zone 3, the molar area.The clinician should determine the availability ofbone in all three zones. Cone beam computed tomography can be used to determine the amount of bone in these zones

as well as in the zygomatic arch, in both horizontal and vertical dimensions. Moreover, any pathology in these areas, as well as in the maxillary sinuses, needs to be verified pre-operatively. In the presence of adequate bone in zones 1 and 2, the clinician can consider the use of four to six conventional implants, tilting the most distal one on each side to achieve good load distribution. As such, one can bypass the need for bone grafting. The anterior extent or position of the sinuses, as well as the slope of the anterior sinus walls, determine both the most posterior position of the distal implant as well as its angulation.

General guidelines for Zygomatic implants:
The general guidelines for zygomatic implants are as follows.

- Adequate bone in zone 1 for two to four axial implants and bilateral lack of bone in zones 2 and 3. Typically, two to four conventional implants are distributed in the anterior maxilla plus one zygomatic implant on each premolar/molar side.
- Adequate bone in zone 1 and lack of bone in zones 2 and 3 on only one side. One single zygomatic implant is placed and conventional implants are placed on the anterior maxilla on the side opposite the zygomatic implant.
- Inadequate bone in zone 1 and adequate pristine bone in zones 2 and 3. An anterior zygomatic implant, together with posterior conventional implants, can solve the problem.
- Lack of bone in all three zones of the maxilla. Four zygomatic implants can be used for the rehabilitation.
- Inadequate bone in zones 1, 2 or 3 in a partially edentulous patient. The placement of three implants to support a partial prosthesis is recommended; use of a zygomatic implant in partially edentulous patients requires more clinical validation before widespread use can be advocated.

A rescue solution for patients in whom either conventional implants and/or the maxillary bone augmentation procedure have failed.

Surgical technique
Anesthesia
According to the original protocol, surgery was carried out under general anesthesia with nasal intubation. A sealing throat pack and a gastric tube were used in each patient. Afterwards, local anesthetic was infiltrated with injections of lidocaine with epinephrine (1:50.000 to block the superior

alveolar nerves(posterior, middle and anterior) and the palatal nerves (posterior and nasopalatal). The epinephrine helped to create a regional haemostasis. Hospital based surgery was strongly recommended for those patients. Recently, the protocol has been simplified with the use of local anesthesia and oral or intravenous sedation. This procedure is recommended if the surgeon is experienced and the procedure is expected to last for <1.5h. The local anesthetic procedure includes the simultaneous use of four different local anesthetic approaches, as follows:

- Normal infiltration anesthesia (1:50.000 epinephrine) in the buccal sulcus from the central incisor to the third molar tooth using lidocaine with1:50.000 epinephrine (about 3.6 ml) and block of the posterior superior alveolar nerve about 1 cm palatal to the bone crest.
- Infra-orbital nerve block by an oral approach using lidocaine (1:50.000 epinephrine) or felypressin with about 1.8 ml of prilocaine.
- Block of the spheno–palatine ganglion throughthe greater palatine foramen using lidocaine(1:50.000 epinephrine) or felypressin with about1.8 ml of prilocaine.
- Infiltration anesthesia around the zygoma area through the skin using about 3.6 ml of lidocaine(1:50.000 epinephrine).

In the authors' experience, the procedure is well tolerated by the patient, and surgery is facilitated by working on a conscious patient.

The original technique

After an initial period during which a vestibular Lefort II type incision is used, the current protocol attempts to expose the area via a mid-crestal incision and vertical releasing incisions along the posterior part of the infra-zygomatic crest and anterior to the surgical site. The vertical ridge/anterior border of the zygomatic arch is always identified. A second landmark is the lateral orbital border, as interference with the orbit must be avoided. Subsequently, a mucoperiosteal flap is raised, exposing the central/posterior part of the zygomatic complex, the lateral wall of the maxillary sinus and the alveolar crest. A retractor is positioned for visibility and to protect the soft tissues.

An indicator is used to determine the drilling direction and the starting point at the crest, usually the second premolar/first molar region. A bone window, around 10 mm wide, is created at the lateral aspect of the maxillary sinus following the desired path of the zygomatic implant from

the sinus floor to the top of the sinus cavity. The sinus membrane is carefully dissected, freed from the sinus walls and placed in the sinus cavity. A series of drills is used to penetrate the alveolar process and the zygomatic bone. The estimated length of the zygomatic implant is selected using a depth gauge. The self-tapping zygomatic implant is placed with the aid of a motor or manually, using an implant mount. Care should be taken not to enlarge the palatal hole during insertion, which is especially important in patients with thin alveolar/basal bone. If needed, bone particles harvested locally can be packed around the implant in an effort to diminish an eventual gap between the implant surface and the palatal bone. A cover screw is placed on the implant and the mucoperiosteal flap is closed. Abutment connection is usually made after a healing period of 6 months, using standard or straight/angulated multiunit Branemark abutments.

Prosthetic procedure

The zygomatic implant has an increased tendency to bend under horizontal loads. This is related to two factors: the greatly increased length of these implants (30–52.5 mm) and the fact that in some circumstances there is limited or no bone support in the maxillary alveolar crest. Consequently,these implants have to be rigidly connected to stable conventional implants in the anterior maxilla. Based on clinical experience and biomechanical theoretical calculations, a full-arch restoration of the maxilla, supported by two zygomatic implants (one on each side), should be assisted by at least two stable conventional implants in the anterior maxilla. The prosthetic procedure follows conventional protocols. As the emergence of the zygomatic implant is often 10–15 mm medial to the ridge, the bridge should be designed to enable proper oral hygiene in the area. Originally, a two-stage procedure was recommended for the zygoma technique .However, over time, the original protocol has been replaced with immediate loading. Several clinical reports have shown good outcomes following immediate/early loading of zygomatic implants in the totally edentulous maxilla. The provisional prosthesis is extremely important for patients treated with zygomatic implants. The goals for such prostheses are to provide acceptable esthetics as well as masticatory and speech function during the healing process, and also to explore the occlusal and esthetic position of the teeth and soft tissue substitutes . The routine option for both provisional and final prostheses is to develop a screw-retained structure that can easily be removed in the event of complications. For this purpose, thesurgeon must analyze the type of

resorption in relation to the opposite dentition and provide an implant head with an adequate abutment type in length and angulation. The angulation of the abutment will be critical, not only for positioning the screw emergence on the palatal/ occlusal surfaces but also for determining the final thickness of the prosthesis. In fact, during implant placement the surgeon must provide the correct implant inclination in relation to the antagonist dentition. The head of the zygomatic implant can be positioned more accurately by observing the screw locking the implant mount to the implant. The screw position duplicates the future abutment screw position exactly.

BASAL IMPLANTS (as shown in fig 38)

Fig 38 BASAL IMPLANTS

Rehabilitation of an atrophied edentulous jaws by placing implants is a challenging procedure. Although various bone augmentation procedure like ridge augmentation, sinus lift are in practice but it may lead to the morbidity of donor's site. Sometimes patient is not willing for such extensive surgical procedures. In such cases basal implants are a viable treatment option. Basal implants derive support from the basal bone area which usually remains free from the infection and less prone to resorption.

“Basal Implant” is a term used in reference to the principles of utilizing basal bone areas which is free of infection and resorption, and the employing of the cortical bone areas. The load bearing tolerance of the cortical bone is many times higher than that of the spongious bone.

Indications of Basal Implants

1. In situations when multiple teeth are missing or have to be extracted.
2. When a bone augmentation procedure has failed.
3. Cases of thin ridges – That is deficiency of bone in buccolingual thickness.
4. Cases where bone height is insufficient

Contraindications of Basal Implants:

1. Medical conditions : A recent history of myocardial infarction (heart attack) would preclude the placement of dental implants. Cerebrovascular stroke, Immunosuppression also lead to the reduction in the efficacy of the immune system.
2. Medicines: An implantologist would require a complete details of all of the medicines and supplements that their patient takes. Drugs of concern are those that are utilized in the treatment of cancer and drugs that inhibit blood clotting.

Advantages Of Basal Implants :

One piece implantology– Basal implants are one piece implants that minimizes the failure of implants due to interface problems between the connections that exist in conventional two and three piece implants.

Disadvantages of the Basal implants:

It is always necessary to keep a few more implants handy to avoid extensive planning including three dimensional exploration of bone conditions. The technique poses substantial challenges, for instructors and users alike, as far as the surgical and prosthetic treatment stages and the substantial knowledge requirements in the fields of biomechanics and bone physiology are concerned.

Basal Implant Types Based on Morphology

There are four basic types of basal implants available-

I Screw Form.
II Disk Form.
III Plate Form.
IV Other Forms

SURGICAL TECHNIQUE

Unlike conventional implants basal implants have a different surgical approach. The technique is simple and easy to execute and does not involve extensive drilling of bone thus avoiding thermal injury. Throughout the surgery the mode of irrigation used is external and usually for almost any case a single pilot osteotomy with a "Pathfinder Drill" is sufficient for KOS, KOS Plus and BCS implants. The kit also consists of manual drills for a controlled osteotomy preparation. Basal implantologists do not advocate raising a flap for these implants as it results in a decreased blood supply and also because of the design of these implants raising a flap is pointless, another factor to be considered is the immediate loading of these implants; a sutured site is not a favorable area to receive an immediate prosthesis.

For the BOI implant the approach towards the bone is gained by raising a flap laterally and cutting into the bone with disk drills of required size in a lateral direction to form a "T" shaped osteotomy. The implant consequently is placed laterally and the flap is closed over it.

Prosthetic Rehabilitation : The aim of prosthetic rehabilitation is to provide esthetics, enable hygiene practice and mainly to avoid overload osteolysis. Esthetics is taken care of by following the three FPs given by Dr. Carl E. Misch. Overload osteolysis is prevented by providing appropriate occlusal schemes which can be bilateral balanced, group function, mutually protected and lingualized occlusion.

PTERYGOID IMPLANTS:

Posterior atrophic maxilla is very challenging to every surgeon to limit the implant placement. There are many surgical techniques described for the reconstruction. In that sinus floor augmentation, alveolar distraction, guided bone regeneration, zygomatic implants and the use of pterygoid, pterygo-maxillary or ptyrego-tubrosity implants

Many surgical techniques have been described for reconstruction of the posterior maxilla, including sinus floor augmentation, alveolar distraction, guided bone regeneration, zygomatic implants and the use of pterygoid, pterygo-maxillary or ptyrego-tubrosity implants . Among all the techniques mentioned above, the most popular one is the sinus floor augmentation, which has gained popularity over the last three decades. However, it has its own drawbacks. The most described complications of

sinus augmentation are sinus membrane perforation, bone graft infection and sinusitis. This extensive surgical intervention could be avoided by utilizing a simpler method, such as pterygoid implants.

Pterygoid implants are anchored in the junction of three different bone structures: The pyramidal process of the palatal bone, the pterygoid process of the sphenoid bone and the maxillary tuberosity. This insertion into three different anatomic structures may often lead to improper terminology usage when relating to pterygoid implants. There is a significant difference between pterygoid and tuberosity implants. Pterygoid implants are engaged in the dense cortical part of the pterygoid bone and the palatal bone, while tuberosity implants are directed and engaged in cancellous maxillary bone of poor quality.Placement of dental implants in the pterygo-maxillary region provides posterior bone support for the prosthesis, without sinus floor augmentation, and can achieve better distribution of masticatory forces in comparison to conventional maxillary implants. This benefit allows rehabilitating patients with satisfactory full arch fixed maxillary prosthesis, which usually spanned from second molar to second molar.

Due to the special architectural features of the pterygo-maxillary area, placement of dental implants in this area is technically more difficult in comparison to other regions of the maxilla. Computer Aided Design - Computer Aided Manufacturing (CAD-CAM) is of great value in planning and placing pterygoid implants, as well as other implants that bypass the maxillary sinus. The surgical guide enables the clinician to determine the exact direction of drilling and the correct length of pterygoid implants. Despite the complexity of this surgical procedure, the risk of complications is very low .A possible major complication that may occur during the surgery is massive bleeding from the maxillary artery or its branches, which are situated 1 cm superiorly to the pterigomaxillary suture. This complication is rare and has not been mentioned in the literature, according to the best knowledge of the authors. Regardless of the surgical technique used, care must be taken to avoid damaging either the maxillary artery or its branches within the pterygopalatine fossa. However, the distance from the inferior end of the pterygomaxillary suture to the maxillary artery is 25 millimeters which makes this area safe for working. Pterygoid implants have a high success rate, minor and infrequent complications and similar bone loss in comparison to conventional implants. Pterygoid implants are considered as a good

alternative for extensive augmentation procedure in patients with atrophic maxilla.

Mini dental implants (MDI) are titanium alloy implant screws that are ultra-small in diameter i.e. l.8 mm wide. These implants come handy in clinical situations where acceptable and satisfactory function cannot be achieved with conventional prosthesis. For example, in patients with flabby ridges, atrophic ridges or in cases with poor availability of residual bone where there is denture instability or lack of retention, commonly seen in edentulous mandible. Conventional dental implants are usually 3.75 to 5 mm wide and require sufficient bone width for implant placement. Hence, in patients with severely resorbed mandibular ridges, conventional implants may not be the best treatment option. In such situations, mini dental implants can be successfully used with immediate loading and ongoing stabilization. They are commonly employed with Type I and Type II bones. In Type I bone the standard propriety thread design can be used and in Type II bone the MDI MAX thread design is used. The advantages of using the MDI system are as follows:

Minimal invasive procedure
Can be inserted in minimal tissue such as resorbed mandibular ridges without relining or grafting techniques

Doesnot require osteotomy
Immediate loading
One stage denture stabilization
Cost effective

Tantalum-implants

A new advancement in the field of implant surface modification is the introduction of tantalum implants. Tantalum is a lustrous transition metal that is highly corrosion resistant. Porous tantalum metal in orthopedic implants was found to be highly successful. This led to its incorporation in the design of root-form endosseous titanium implants as a new form of implant surface enhancement. Tantalum being highly resistant to chemical attack provokes minimal adverse biological response in reduced or oxidized forms. It helps improving the contact between the dental implants and osseous structure thereby facilitating osseointegration. It has been found to enhance osseointegration by combining bone ongrowth along with bone ingrowth or osseo-incorporation.

Role of Maintenance and Recall in Prevention:

"The dentist of the future will not be judged by the excellence of his margins, but by how well he motivates his patients to practice correct oral hygiene. The dentist's success will be favourable only if the patient returns in six months, and then regularly, and returns each time with an absence of plaque." - Boitel.

A special effort should be made to avoid the careless handling or dropping of a removable prostheses. If it is distorted, it may result in destructive pressure on the teeth. Sometimes, appliance itself can be damaged. Proper maintenance of the prostheses using various physical and mechanical methods such as brushing with soft bristles and cleaning with cleansing solutions(as shown in fig39)

a.Denture cleansing brushes b.Denture cleansing solutions

Fig : 39 Cleansing aids

will keep the prostheses free of plaque, thereby ensuring better tissue health.

Under no circumstances, self-correction of the appliance or home-lining should be performed. A caries susceptible individual should follow an adequate control program in an attempt to arrest this condition. This program should include both professionally applied treatments, and intensive program of daily treatment administrated by the patient at home. Frequent rebasing of an extension base prosthesis will maintain adequate support. Patient should be instructed in special plaque control measures, especially around pontics and connectors of fixed partial denture.

CONCLUSION

Though prosthodontics has evolved highly as a specialized field in replacement of missing teeth and adjacent soft and hard oral tissues; the cooperation with other aspects of dentistry, especially preventive cannot be ignored. Meeting the expectations of an ever increasing elderly population with quite rightly youthful outlooks of both function and esthetics is demanding.The loss of several teeth doesn't have to be an immediate threat to the function of the whole dentition, but it can initiate serious problems related to the whole orofacial region, psychics and the wellbeing of the patient. From this point of view prosthetic dentistry is a valuable tool with high therapeutical and preventive character.

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