Prosthodontic

5th class

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Complications in complete denture wearers

The flabby ridge

This condition is most frequently seen in the upper anterior region. The bone becomes grossly resorbed, often up to the level of the anterior nasal spine, and it is replaced by fibrous tissue. As a result of this mobile fibrous tissue, the stability of a complete denture will be poor, both function and appearance can be heavily compromised.

Aetiology

It has long been believed that the condition, sometimes called the 'combination syndrome', is caused by the presence of lower natural teeth. This is probably not surprising when the many factors that influence bone metabolism are

considered. Nevertheless, it is probably wise to keep such patients under regular review to ensure that a dramatic level of damage is not occurring.

Management

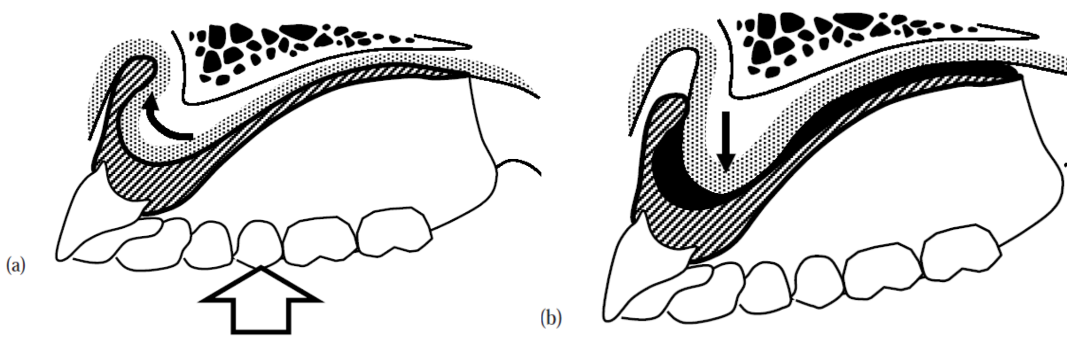
Approaches to treatment:

The management of this condition is somewhat controversial, opinion falling into two camps:

1. **surgical removal of the fibrous tissue** is favoured in every case where the health of the patient allows. This approach produces a firm ridge which is reduced in size. Advocates of the opposing view suggest that surgical removal should rarely, if ever, be carried out because the fibrous tissue may have a cushion effect which reduces trauma to the underlying bone. If the tissue is removed, it must be replaced by denture base material with consequent increase in the bulk and weight of the prosthesis.
2. **Non-surgical treatment:**

A key aspect in the non-surgical management of the flabby ridge is the choice of impression technique employed:

a. employ a *mucodisplacive impression technique* which compresses the flabby tissue in order to try and obtain maximum support from it or,
b. use a *mucostatic impression technique* with the aim of achieving maximum retention.



(a) Under occlusal pressure, the upper denture is seated and the flabby anterior ridge
(b) When the teeth are apart, the flabby tissue recoils and displaces the denture downwards.

Denture breakages

Midline fracture of the complete upper denture accounts for 29% of all repair work in dental laboratories, whilst teeth deboned from complete dentures account for 33%These two common problems will be considered.

Types of fracture

a. **Fatigue of the acrylic resin:**

   Fatigue fracture results from repeated flexing of the denture by forces too small to fracture it directly. Failure of the denture base is due to the progressive growth of a crack originating from a point on the surface where an abrupt change in the surface profile causes a localised concentration of stress many times that applied to the bulk of the denture. The crack often starts palatally to the upper central incisors, grows slowly at first but undergoes an enormously increased rate of growth just before the denture fractures. A failure of this type most commonly occurs in dentures that are about 3 years old. Midline fracture due to fatigue of the acrylic resin is the commonest type of denture breakage.

b. **Impact:**

Denture breakage might occur, for example, if the patient *accidentally drops the denture* while cleaning it. It might also result from an accident in which the *patient receives a blow to the mouth*. Whenever possible, the cause, or causes, of the fracture must be identified before the denture is repaired or replaced. Unless this is done and the cause attended to, the denture is likely to fracture again within a short period of time.

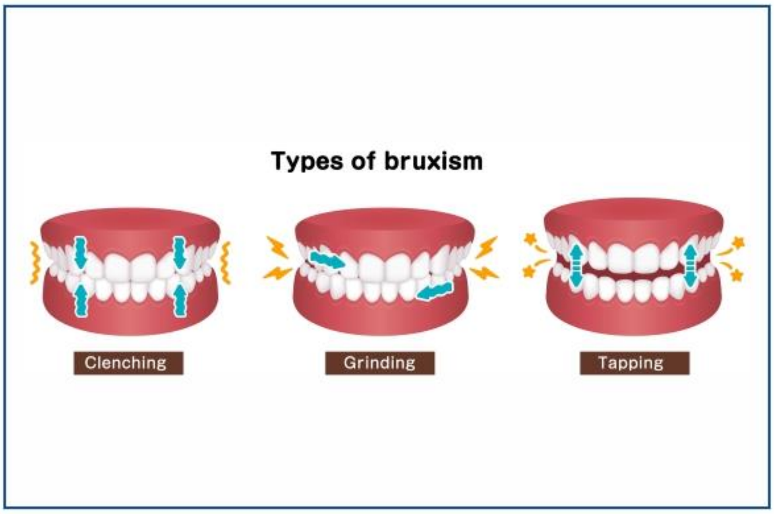
Causes of fracture:

a. Denture factors

- Stress concentrators.
- Absence of a labial flange.
- Incomplete polymerisation of the acrylic resin.
- Previous repair.
- Shape of the teeth on the denture.
- Poor fit.
- Lack of adequate relief.

b. Patient factors:

- Anatomical factors: a prominent labial frenum will require a deep notch in the flange resulting in stress concentration in that area.
- High occlusal loads: These may occur in patients with powerful muscles of mastication, or whose natural lower teeth are still present, or who have a bruxism.



c. Debonding of teeth:

The usual reasons for a weak bond between tooth and denture base are:

- The presence of tin-foil substitute on the ridge-lap surface of the tooth.
- The presence of residual wax on the same surface.
- The use of cross-linked teeth which are incompatible with the particular denture base polymer.

There are various recommendations that have been made for minimising the risk of debonding, the following have received fairly widespread support

1. **Choose artificial teeth and a denture base polymer which are compatible** by checking the information sheets provided with the products or by seeking information from the manufacturers. Conventional denture teeth tend to achieve a higher bond strength than cross-linked teeth.
2. **Ensure all traces of wax and tin-foil substitute are removed**. The complete removal of wax is not consistently achieved with boiling water alone, so for optimum bond strength the use of a wax solvent is recommended.
3. **Drill small channels into the palatal surface of the teeth to increase the area available for the polymerising denture base resin.** However, it needs to be remembered that such recesses in the ridge-lap surface of the teeth can make complete wax removal more difficult. Therefore, particular care needs to be taken when removing the wax, otherwise the adjustments can result in a weaker, rather than a stronger bond.
4. **Apply a solvent such as dichloromethane to the ridge-lap surface of the teeth.** The solvent creates microscopic pores and channels which promote diffusion of the polymerizable materials.

5. **Use a heat-curing denture base polymer.** This material polymerises more slowly than a cold-curing material and ensures better penetration into the tooth substance.

Gagging reflex (retching)

It´s a protective reflex which guards the airway and posterior oropharynx, may occur during prosthetic procedures such as impression taking, or when dentures are worn or, in extreme cases, when a mouth mirror is placed on the lips or tip of the tongue. Five regions in the oral cavity have been identified as the major trigger zones for initiating the gag reflex. They are the base of the *tongue*, *fauces*, *palate*, *uvula*, and *posterior pharyngeal wall*.

Aetiology

There are a number of causes that may be conveniently grouped together as follows:

1. **Somatic**: The term ‘somatic’ covers those situations where the reflex is triggered by tactile stimulation of the soft palate, posterior third of the tongue.
2. **Iatrogenic**: Iatrogenic causes, which are related to the dentures, are numerous. Some patients begin to retch after new dentures are inserted, but in most cases, this reflex soon disappears as they adapt to the dentures. However, the reflex may persist if there are faults with the dentures such as an excessive occlusal vertical dimension, or if the dentures are stimulating the sensitive areas of the soft palate and tongue directly.

This stimulation may be caused by palatal over-extension, a posterior border which is too thick or poorly adapted, the teeth encroaching on tongue space or indeed by any factor producing denture instability.

An upper denture whose posterior border is under-extended posteriorly can provoke gaging because as the edge of the denture terminates on relatively incompressible mucosa a satisfactory post-dam cannot be produced. This result in poor retention, which increases denture instability, stimulates the tongue and palate, and causes apprehension in the patient. When this diagnosis is established, it requires a very careful explanation by the dentist to convince the patient that to cure the problem it will be necessary to cover more, rather than less of the palate.

3. **Psychogenic**:

   Psychogenic causes may arise from sight, sound or thought. They include the sight of impression material being mixed or the sound of another patient retching. The patient may be extremely apprehensive because of an unhappy first experience of dental procedures or as a result of disturbing stories from friends. In rare instances, retching may be a manifestation of a psychological disturbance which is not primarily related to the patient's dental treatment.

4. **Systemic**:

   Less frequently, the causative factor may be systemic disease, particularly conditions affecting other regions of the gastrointestinal tract; for example, the link between retching and alcoholism may be related to the persistent gastritis found in such patients. Persistent catarrh will prevent nose breathing and may contribute to the problem of retching.

Patient management:

a. **Assessment of the severity of the problem:**

   A carefully taken history will reveal the severity of the problem and provide clues as to the cause. For example, a situation where a patient has been able to tolerate the clinical stages of denture construction, but then has difficulty in wearing the finished dentures, points to an iatrogenic cause which should be treated relatively simply by correcting the error in denture design.

b. Impressions:

Most of individuals find impression taking unpleasant. However, retching during impression taking can usually be prevented by the following:

1) Reassurance and relaxation.

It is very important that the dentist has a confident and relaxed chairside manner. It is essential that the anxious patient is reassured and encouraged to relax both physically and mentally. The dental nurse can also play a major role in creating an appropriate state of mind in the patient.

2) Position of the patient.

The dental chair should be adjusted so that the patient is sitting comfortably in the upright position.

3) Breathing through the nose.

Instructing the patient to breathe through the nose while the tray is being tried in the mouth or the impression is being taken is one of the most helpful methods of preventing retching. During nasal breathing the soft palate remains stationary in its low position and the tongue in its 'guarding' position, protecting the nasopharynx from the threat of the foreign body in the mouth. If the patient breathes through the mouth, this protection is lost and movement of the soft palate results in intermittent contact with the setting impression material, increasing stimulation.

4) Impression technique.

Impression trays should be well fitting. As close-fitting special trays are less bulky than spaced trays, they are better tolerated and should be used whenever possible. When trying trays in the mouth, firm, positive movements should be used. Most patients tolerate the lower impression better than the upper one, so if the lower impression is taken first, the success of the procedure is likely to reassure the patient. The impression material should be mixed or prepared out of sight of the patient and the amount placed in the tray kept to the minimum necessary to record the relevant structures. A saliva ejector should be used if copious amounts of saliva collect in the floor of the mouth.

5) **Distraction.**

   It is during the insertion of the impression and while the material is setting that it is particularly important to distract the patient's attention from what is going on. This may be achieved by the dentist talking about something that is known to be of particular interest to the patient, or by reinforcing the requirement that the patient continues to breathe slowly and steadily through the nose. It has even been suggested that the patient be asked to raise one leg and to concentrate on not lowering it until the impression has set.

The severe gagging reflexes

The **first** challenge when trying to treat a patient who has this problem is to obtain an accurate impression so that a well-fitting denture base can be constructed. The **second** challenge is to provide a prosthesis that can be worn by the patient for a reasonable length of time.

The following approaches to the management of this difficult problem have been found useful:

1) **Conscious sedation**
2) **Acupuncture**. The gag reflex has been shown to be capable of being controlled by acupuncture. Although there is evidence to show that the technique is of assistance when undertaking the various clinical stages of denture construction there is, as yet, no evidence that it can be used by the patient to allow the denture to be worn.

3) **Hypnosis**. Hypnosis has been used in the treatment of severe cases its success is dependent upon the patient being well motivated and being able to practise self-hypnosis, thus enabling a denture to be worn outside the dental clinic.
4) **The training denture.** The training denture approach may be of value when treating any patient with a long history of difficulties which suggest frank denture intolerance, including retching.

The burning mouth syndrome

The burning mouth syndrome (BMS) can be very troublesome to the patient, presents problems of diagnosis and often involves prolonged treatment. The symptoms occur in **5 - 7%** of the adult population. Of those who seek treatment, there is a predominance of women, with a mean age of approximately 60 years. The most common sites of the complaint are the **tongue** and **the upper denture-bearing tissues**. Rather less common are the lips and lower denture-bearing tissues. The oral mucosa appears normal. Many of the BMS patients have consulted a number of health care professionals before seeking help from the dentist or dental specialist. They know of no other people with the complaint and therefore feel quite isolated. If several professionals have stated that the mouth looks normal the patient may start to feel as if ‘it is all in the mind’. The level of anxiety is consequently raised and cancerphobia may well develop.

Classification

Three types of BMS have been described. The classification is useful as it points the way towards appropriate treatment and a probable prognosis.

Type 1

There are no symptoms on waking. A burning sensation then commences and becomes worse as the day progresses. This pattern occurs every day.

Approximately 33% of patients fall into this category and are likely to include those with haematinic deficiencies and defects in denture design.

Type 2

Burning is *present on waking and persists throughout the day*. This pattern occurs every day. About 55% of patients are placed in this category, a high proportion of who have chronic anxiety and are the most difficult to treat successfully.

Type 3

Patients have symptom-free days. *Burning occurs in less usual sites such as the floor of the mouth, the throat and the buccal mucosa*. This category is made up of the remaining 12% of patients. A study of this group has shown that the main causative factors are allergy and emotional instability. The investigation of these patients is likely to include patch testing.

Aetiology

BMS has been attributed to a multitude of causes and these broadly fall into three groups:

1. Local irritants including denture faults
2. Systemic factors
3. Psychogenic factors.

1. Local irritation

a. Denture faults: Errors in denture design which cause a denture to move excessively over the mucosa, which increase the functional stress on the mucosa or which interfere with the freedom of movement of the surrounding muscles may initiate a complaint of burning rather than frank soreness. Denture design errors have been discovered in 50% of BMS patients.

b. *Residual monomer:* High levels of residual monomer in the denture base have been reported and the tissue damage produced is considered to be the result of chemical irritation rather than a true allergy. It is possible that high levels of residual monomer, which have ranged from 3-10 times the normal value, are due to errors inadvertently introduced into the short curing cycles which are popular with manufacturers and dental laboratories. If the requisite curing temperature of 100°C is not achieved in the relevant part of the short curing cycle, there is a marked increase in residual monomer content. Some authorities may not consider this condition to be an example of BMS were, classically, the mucosa looks normal. However, a patient who reacts to a high level of residual monomer complains of a burning sensation and so we feel justified in including it.

c. *Micro-organisms:* The role of micro-organisms in burning mouth syndrome is controversial and studies have not shown a link between the presence of Candida albicans and the complaint.

d. *Smoking and mouthwashes:* Smoking and the regular use of some mouthwashes are irritants that have been implicated in BMS.

2. Systemic causes:

a. *Nutritional deficiencies:* Contributions from nutritional deficiencies such as iron, vitamin B complex and folic acid should be highlighted. An example of BMS caused by a deficiency. Iron deficiencies have been found in 8% and folic acid deficiencies in 6% of BMS patients. Low blood levels of vitamin B_1 and B_6 were found in 40% of patients.

b. *Endocrine disorders:* What is apparent is the relative unimportance of the climacteric as a causative factor, a modern viewpoint which is at variance with past clinical opinion. On rare occasions, the symptoms are found to be linked with an undiagnosed diabetes mellitus. Treatment of the medical condition invariably results in complete resolution of BMS.

Xerostomia, frequently associated with BMS. One that should be highlighted here is drug-induced xerostomia. Recent investigations have produced evidence of a link between BMS and reduced parotid gland function and of antidepressant medication reducing the salivary flow. It should be recognised that the presence of a dry mouth is capable of accentuating the symptoms initiated by any of the causes of local irritation. This is an example of the multifactorial nature of BMS.

c. *Hypersensitivity*

   True hypersensitivity to constituents of denture base polymer is rare and usually results in local symptoms such as burning or itching. In one instance where there were systemic symptoms of nausea, dizziness and general malaise the patient was found to have reacted to dyes used to colour the polymer. Dentures made of clear polymer proved successful.

d. *Parkinson's disease*

   It has been reported that the prevalence of BMS was 24% in people suffering from Parkinson's disease.

3. **Psychogenic causes:**

   The more common disorders associated with BMS are anxiety, depression, cancerphobia and hypochondriasis. The associated parafunctional activities such as bruxism and abnormal and excessive tongue movements are capable of inducing mucosal irritation.

Management

Faced with a multitude of causative factors, it will be recognised that the process of diagnosis and treatment is usually a time-consuming affair.

- Initial assessment (history/examination/special tests).
- Provisional diagnosis.
- Initial treatment (e.g., elimination of local irritants and investigating and treating haematinic deficiencies).

- Assessment of initial treatment.
- Definitive diagnosis.
- Definitive treatment (local/systemic correction/psychological therapy).
- Follow-up.

With regard to outcome, analysis of various studies suggests that about 2/3 of BMS patients are either cured or improved to such an extent that the burning sensation is no longer an overwhelming problem. There remain a group of patients for whom the current state of knowledge can offer relatively little benefit. Some in this small group remain totally resistant to treatment. However, it should be remembered that even in these refractory cases BMS is not necessarily a life sentence as spontaneous remissions can eventually occur for no apparent reason.

Disturbance of speech

The presence of complete dentures can modify speech by affecting articulation and by altering the degree of oral resonance. A number of sounds are articulated by contact of the tongue to the palate and to the teeth. A change in speech that may be quite marked when the dentures are first inserted will usually disappear completely within a few days. However, if the changes in the contact surfaces require a modification of tongue behaviour that is beyond the adaptive capability of an individual patient, a speech defect will persist. It should also be remembered that the *tongue* of a patient who is wearing complete dentures has a dual function to take part in *speech articulation* and to *control the dentures*. If the dentures are loose, the demands of this latter function may be so great that there is a general deterioration in the quality of speech. As mentioned, the following relationships are particularly important to the production of clear speech.

1. Tip of the tongue to the palate.

Contact between the tip of the tongue and the palate is required in the production of /s/, /z/, /t/, /d/ and /n/. Consequently, a change in the shape or thickness of the denture contact surface resulting from the fitting of new dentures will require a modification of tongue behaviour in order to produce sounds which are the same as before. In the vast majority of cases, the necessary modification occurs without any difficulty in a relatively short period of time.

The sound most commonly affected in this way is /s/, a sound which is generally produced with the tongue tip behind the upper anterior teeth. A narrow channel remains in the centre of the palate through which air hisses. If the *palate is too thick* at this point, or if the *incisors are positioned too far* palatally, the /s/ may become /th/. If the denture is shaped so that it is difficult for the tongue to adapt itself closely to the palate, a channel narrow enough to produce the /s/ sound will not be produced and a whistle or /sh/ sound may result. This is most likely to be the consequence of excessive palatal thickening laterally in the canine region.

2. **Lower lip to incisal edges of upper anterior teeth**.

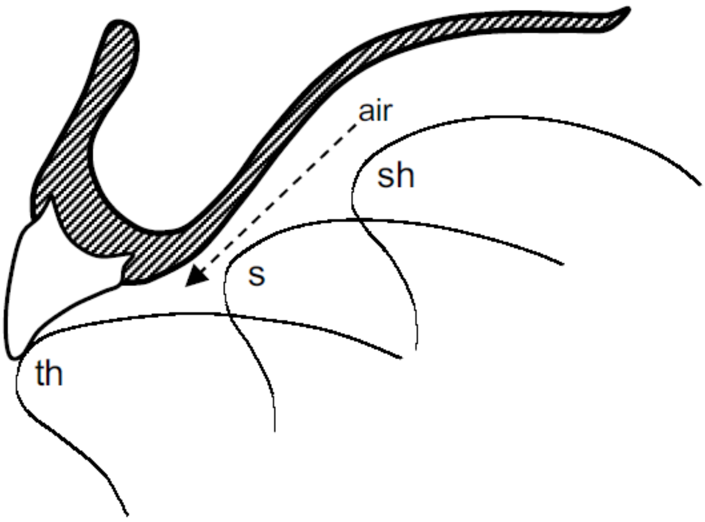
The lower lip makes contact with the incisal edges of the upper anterior teeth when the sounds /f/ and /v/ are produced. If the position of these teeth on a replacement denture is dramatically different to that on the old denture there is likely to be a disturbance in speech.

3. **Lateral margin of the tongue to posterior teeth**.

Contact between the lateral margins of the tongue and the posterior teeth is necessary to produce the English consonants /th/, /t/, /d/, /n/, /s/, /z/, /sh/, /zh/ (as in measure), /ch/, /j/ and /r/ (as in red). Air is directed forwards over the dorsum of the tongue and may be modified by movement of the tongue against the teeth or anterior slope of the palate to produce the final sound. If the contact can only be achieved with difficulty, movement of the tip of the tongue may be restricted with consequent impairment of speech. This difficulty arises if the posterior contact surfaces are too far from the resting position of the tongue as a result of the occlusal plane being too high, the occlusal vertical dimension too great or the posterior teeth placed too far buccally. In extreme cases, it may not be possible for the tongue to produce a complete lateral seal and so a lateral sigmatism develops.

4. The relationship of mandible to maxilla.

The mandible moves closest to the maxilla during speech when the sounds /s/, /z/, /ch/ and /j/ are made. Normally, at this time, there will be a small space between the occlusal surfaces of the teeth. However, if the occlusal vertical dimension of the dentures is too great, the teeth may actually come into contact so that the patient complains that the teeth clatter.



The position of the tongue for producing the sounds */th/*, */s/* and */sh/*.

Complications in complete denture wearers

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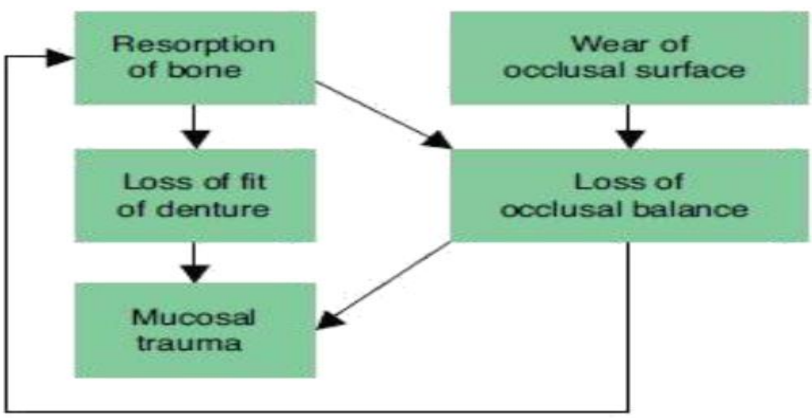
The recall appointments after fitting complete dentures considered as an important programme, to ensure that the tissues are not being damaged and the dentures are functioning efficiently and comfortably. A recall visit also gives the patient an opportunity to seek advice over any concerns. To reduce the risk of mucosal damage and bone resorption in complete denture wearers, a check should be made every year. It is important that the patient is not under the mistaken belief that once the artificial substitute for the natural teeth has been provided there will be no further problems and no need for further maintenance.

Epidemiological studies of edentulous population have shown that most patients with complete dentures have pathologic tissue changes that require treatment. **Long term recall appointments done because the following changes occurred:**

- Mucosal changes
- Bone resorption
- Occlusal changes
- Adaptation of patient.



Cycle of tissue damage resulting from lack of denture maintenance

Mucosal changes:

In 2007, in the UK, there were 5325 new cases and 1841 deaths, with an increased prevalence in deprived communities. It should be emphasised that the typical edentulous patient falls into a risk group, as a retrospective study of patients with oral cancer showed that 59% were edentulous, tended to be older than 60 years, were tobacco and alcohol users, had a lower socioeconomic status and had a somewhat negative attitude to recall appointments.

Bone resorption:

The long-term changes in shape of the residual ridges and the consequent effect on dentures have been studied extensively. A continuing reduction in height of the alveolar ridges over a period of 25 years has been observed. There appears to be a marked reduction in the first year of denture wearing and in the next few years a continuing loss averaging 1 mm each year. Over periods of time, the loss in height of the anterior lower ridge is four times that of the upper. As the lower denture covers a much smaller area, the functional stress transmitted to the underlying tissues is greater than that to the upper tissues; thus, it is likely that the greater loss of mandibular bone is due to the physiological limit of this tissue being exceeded. The resorption of bone brings in its wake a loss of both occlusal vertical dimension and rest vertical dimension. The former dimension is reduced to a greater extent and thus the freeway space is increased.

Occlusal changes:

The progressive loss of fit of dentures, resulting from resorption of bone, also leads to deterioration in occlusal balance. In the case of dentures with acrylic teeth this occlusal deterioration can be aggravated by occlusal wear. The combination of loss of fit and occlusal imbalance encourages mucosal inflammation and further bone resorption, thus establishing a vicious cycle. It is clearly important, if oral health and function are to be maintained, that this cycle is broken by regular denture review and effective maintenance.

Adaptation of the patient:

The progressive long-term deterioration of dentures that has been described is not invariably associated with a complaint. This is because adaptive changes can occur and a tolerance can develop which allows patients to continue wearing the dentures. Thus, a considerable amount of tissue damage can go unnoticed. Whereas successful adaptation to new dentures is a prerequisite for success, a patient who tolerates slowly developing faults beyond a certain point will store up troubles for the future. In addition to the likelihood of tissue damage, reduction in rest vertical dimension and the adoption of abnormal mandibular postures create problems for both the clinician and the patient when replacement dentures are eventually required.

The first long-term recall appointment should be made no more than a year after the dentures were first fitted. Thereafter, an appointment every 2 or 3 years to check on tissue health and quality of the dentures is a realistic arrangement, on the mutual understanding that the patient will attend sooner if problems develop in the meantime. The clinician should make the point that the dentures have a limited life and should stress to the patient the potential dangers of wearing dentures that have become inadequate.

Treatment required at long-term recall appointments will be one, or a combination, of the following:

- Adjustment of the impression surface.
- Correction of denture base extension.
- Occlusal adjustment with or without a check record
- Reline or rebase of the dentures
- Construction of replacement dentures.

Following prosthetic complications have been recorded as a result of research done by Hakan B. et al 2012 for complete denture wearers:

1. Loss of retention (62.5%)
2. Existence of any denture irritation or ulceration (51.6%)
3. Existence of any debonded/fractured artificial teeth (26.6%)
4. Existence of any fracture in the denture base (31.3%)
5. Existence of denture stomatitis (9.4%)
6. Existence of epulis fissuratum
7. Existence of inflammatory papillary hyperplasia

Some Clinical Problems and Solutions associated with complete denture

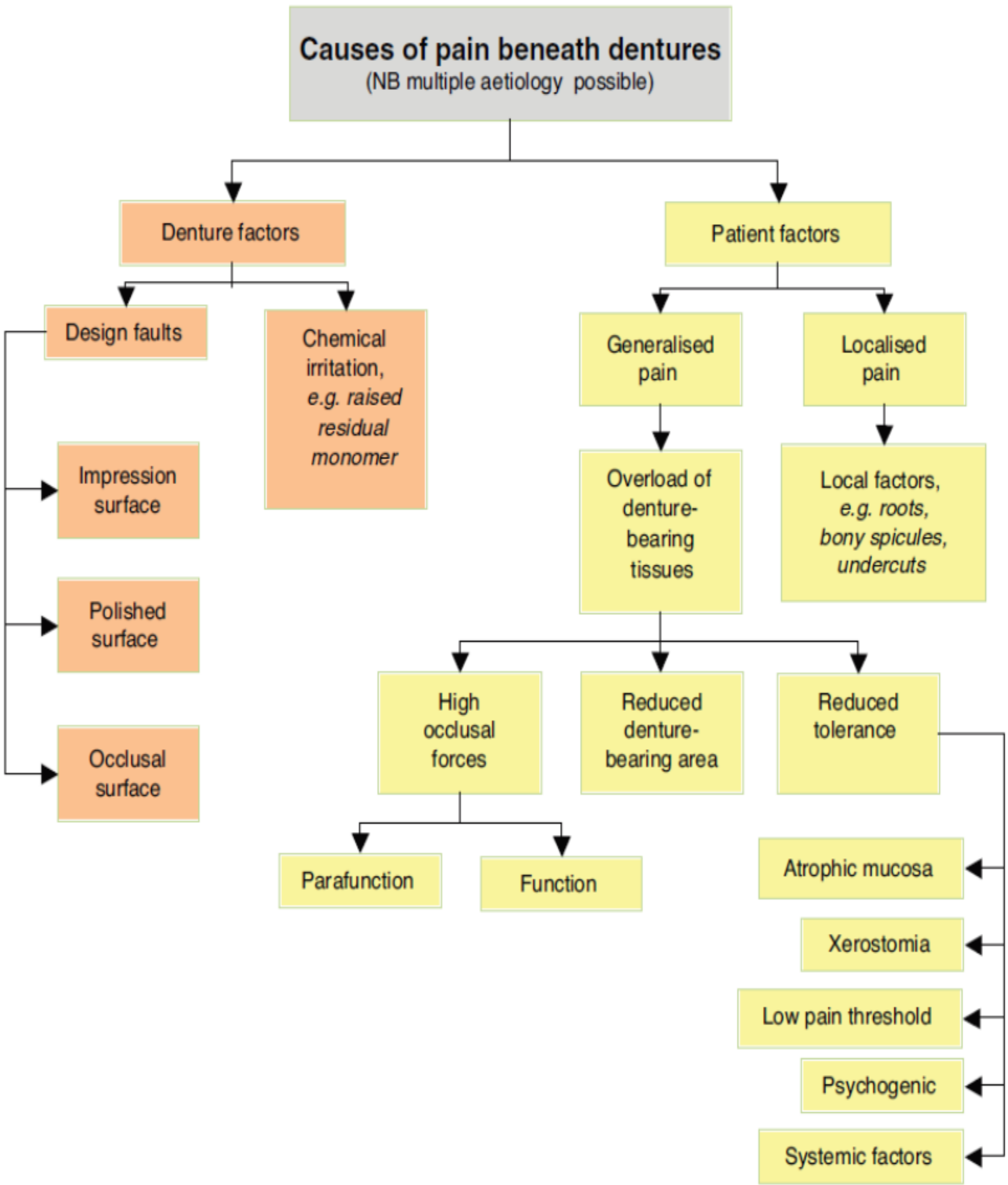
- Pain and instability
- Lack of saliva
- Hard and soft materials for modifying the impression surface of dentures
- The flabby ridge
- Midline fracture
- Debonding of teeth
- Gagging reflex
- The burning mouth syndrome
- Disturbance of speech.

Pain and instability:

The most common problems associated with complete dentures are pain and instability of the dentures. They are summarised in the table below. The most likely main complaints have been indicated in each case. However, it should be remembered that there is considerable overlap between the two columns, as any cause of instability may additionally give rise to a complaint of pain. It should also be stressed that there may be more than one cause of a complaint.

Persistent pain:

This problem is more often seen in the lower jaw where the area available for distribution of the occlusal load is relatively small. As noted in the table below, there are many possible causes of this complaint, which may be attributed to the denture design and to the patient.



A diagnostic flow chart of the various possible causes of pain beneath dentures

Discomfort can arise from overloading of the mucosa as a result of clenching or grinding the teeth. These occlusal habits are caused by increased activity of the masticatory muscles produced during stressful situations.

In treating parafunction,

- the patient must be made aware of the problem and should be told that teeth should be out of contact for most of the time.
- It is important to reassure the patient, describe the link between stress, parafunction and pain under dentures and point out that there is no change in the oral mucosa.
- The importance of conscious relaxation should be emphasised and the patient should be strongly encouraged to leave out both dentures, or at least the lower denture at night.

Another complication is Lack of saliva

Functions of saliva

Saliva possesses the following functions in the edentulous patient:

- **Denture retention**: saliva is an essential component in the physical retention of complete dentures.
- **Lubrication:** the glycoproteins in saliva facilitate movement of the soft tissues during speech, mastication and the swallowing of food.
- **Cleansing:** saliva physically washes food and other debris from the soft tissues and from the polished surfaces of prostheses
- **Taste:** flavours are perceived only when substances are in solution in saliva or other fluids. It prepares food for swallowing and facilitates the sense of taste
- **Digestion:** digestion begins during mastication when salivary amylase starts to breakdown glucose.

- **Antimicrobial:** there are antimicrobial components, such as antibodies, in saliva which help to maintain a normal balance of the oral flora.

Problems of reduced salivary flow

A reduction, or absence of saliva (xerostomia), is likely to cause problems with all the functions listed above so that a general and significant, reduction in the quality-of-life results. Reduced retention of dentures is a particular problem for edentulous patients. There may also be an increased susceptibility to denture trauma resulting in complaints of pain and in some case the burning mouth syndrome

Aetiology of reduced salivary flow

- **Medical History:** A full history is taken including a 'I'm taking an anti-depressant and question on current medication **a diuretic** "For how long have you been" 'One year' **dry mouth** is a possible taking these tablets?' contributory factor to the oral complaint
- **Social History:** The history has revealed a number of possible causes of the persistent pain. The diagnosis can be established only after a careful examination of the patient, the mouth and the various sets of dentures in order to confirm or deny the various possibilities. The point should be made that unless a full history is obtained some of the possible causes might never be revealed. The provision of new dentures would do little to eliminate the problem if the persistent pain was due to a dry mouth and to parafunction.

However, the condition is relatively common in middle-aged and older people, the main candidates for complete dentures, with between 12% - 16% complaining of a dry mouth.

The commonest causes of dry mouth are:

- **Adverse effects of drug therapy**, e.g., tricyclic antidepressants, beta-blockers
- **Depression and chronic anxiety**
- **Dehydration**
- **Mouth breathing**
- **Auto-immune disease** like Sjögren's syndrome
- **Head and neck radiotherapy**
- **Poorly controlled diabetes**
- **Smoking**.

A complaint of dry mouth can occur in the absence of the clinical signs of dryness ('symptomatic xerostomia'). Under such circumstances the physical retention of the dentures would not be expected to be diminished.

Management of dry mouth

In clinical xerostomia there are intra-oral signs of dryness such as a dry, atrophic mucosa and lack of saliva pooling in the floor of the mouth. The dentist can check the dryness of the buccal mucosa simply and quickly during the examination of the patient by carrying out the 'mirror test'. For this the dentist lightly presses the face of the mirror against the buccal mucosa and then tries to remove it. If the mirror comes away easily the mucosa is still covered by a substantial film of saliva; if the mucosa adheres to the mirror, then it is dry.

Close collaboration with the patient's general medical practitioner or with a specialist in oral medicine is often necessary. It might be possible, for example, to change an existing xerostomic drug to one less liable to reduce salivary flow. As there is a definite relationship between fluid intake and secretory performance it is essential that the patient is kept well hydrated. *Chewing* and *energetic exercises* improve salivary flow, possibly because of improved blood circulation to the glands. In cases where flow rate cannot be improved limited relief may sometimes be obtained by the use of artificial saliva.

Measures for managing xerostomia: may be **local** or **systemic**

Local measures:

1. **Artificial saliva:** In cases where the salivary flow rate cannot be improved limited relief may sometimes be obtained by the use of artificial saliva.
2. **Denture and oral hygiene:** It's very important for a denture patient with a dry mouth to maintain an excellent level of denture hygiene. The likelihood of the proliferation of *Candida albicans* and other microorganisms is increased in xerostomia and therefore unless denture hygiene is maintained at a high level the denture is likely to be rapidly colonised by the micro-organism, resulting in denture stomatitis. Motivation and instruction of the patient, followed by monitoring the quality of denture hygiene are essential.
3. **Denture retention:** In cases where an intractable dry mouth gives rise to a persistent problem of loose dentures, a denture adhesive will usually provide some improvement in denture function.

Systemic measures:

1. **Treatment of an underlying disease**: It might be possible, for example, to change an existing xerostomic drug to one less liable to reduce salivary flow. Also, if the patient is diabetic, an improved glycaemic control will alleviate the xerostomia.
2. **Increasing fluid intake**: As there is a relationship between fluid intake and secretory performance, it is essential that the patient is kept well hydrated.
3. **Sialagogues**: *Pilocarpine* can stimulate salivary flow where some functional salivary tissue remains, particularly in drug-related xerostomia, but it commonly has unpleasant side effects such as increased sweating.

The dry mouth may also be occasionally alleviated by sialagogues such as sugar-free chewing gum, glycerine or ascorbic acid and lemon mouthwash.

Cleaning dentures it should be done for deposits form on dentures such as:

- Microbial plaque
- Calculus
- Food debris.

These deposits may be responsible for a variety of problems including:

- Denture stomatitis
- Angular stomatitis
- Unpleasant tastes
- Odours
- Unsightly appearance
- Accelerated deterioration of some denture materials such as short-term soft lining materials.

The effective cleaning of dentures is therefore of considerable importance to the patient's general well-being and oral health.

- Inflammatory Papillary Hyperplasia, Candidiasis and Wearing ill-fitting dentures 24h/7 days, are contributing factors. Resolve before making new dentures because, if left as it, new dentures will be loose after placement, as inflammation resolves.

Treatment by:

- Leave dentures out at night.
- Reline with tissue conditioner.
- Nystatin mouth rinse

In cases where an intractable dry mouth gives rise to a persistent problem of loose dentures a denture adhesive will usually provide some improvement in denture function.

Hard and soft materials for modifying the impression surface of dentures Materials which can be used to modify the impression surface to overcome some of these problems; these materials can either be applied by the dentist at the chairside or by the dental technician in the laboratory.

The materials may be classified as follows:

• Hard materials

• short-term soft lining materials

• long-term soft lining materials.

Hard materials

Recent years have seen the development of a group of useful materials, frequently described as chair side reline materials, which can be used to modify the impression surface of an existing denture.

Composition

Commonly these materials consist of a **powder** containing polyethylmethacrylate together with a liquid monomer, butylmethacrylate. The important point to make is that monomeric methylmethacrylate, a tissue irritant, is avoided. Many of the products include a primer to enhance the adhesion of the material to the existing denture polymer. The available materials vary in working time, setting time and viscosity. These materials can be useful for relining dentures. As they can be used at the chairside a ‘one-step’ reline technique can be employed.

Clinical applications: This has great benefits in the following situations:

1. A laboratory reline would require the patient to be without any denture for an inconvenient length of time. (patient have one set of denture and socially unacceptable to be without denture and in case of immediate denture patient).
2. A reline is required, but it is not necessary for it to last for much longer than a year. (The immediate denture patient is likely to fall into this category, as after a year the chairside reline will usually need replacing by a permanent rebase or by a replacement denture.
3. Where a direct technique is indicated. (A chairside reline).

Clinical performance:

Clinical trials have shown that the best of this group of materials are convenient to use and provide immediate improvement of fit and comfort. Over a period of time there is a loss of material, especially at the borders of the denture; this loss is more apparent in the lower denture. However, the loss does not appear to cause marked deterioration of fit or comfort. The better materials should be regarded as having a working life of about one year. The surface can be cleaned in the normal manner and there is relatively little discolouration.

Short-term soft lining materials

Most materials are supplied in a powder/liquid form. An alternative presentation is in a ready-to-use sheet form which can be found in one product available to the dental profession and in several ‘over the counter’ products available directly to the general public.

It is essential that traumatised tissue is examined by the dentist and that rational, rather than empirical, treatment is prescribed.

The composition of the powder/liquid types is as follows:

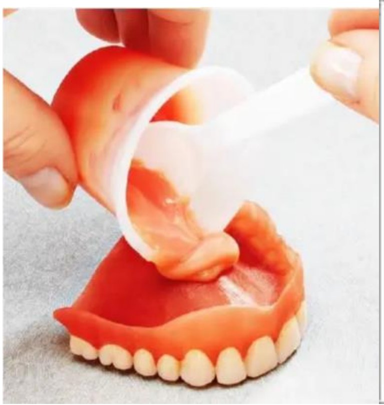
1. **Powder:**

   Polyethylmethacrylate, or copolymers of polyethyl/methylmethacrylate.

2. **Liquid:** A mixture of:

a) ***an aromatic ester***, such as dibutyl phthalate which acts as plasticiser

b) ***ethyl alcohol***.



Clinical applications

Short-term soft lining materials are placed in existing dentures for the following reasons.

1. **Tissue conditioning**: For tissue conditioning, the material is applied for a period of a few days to the impression surface of a denture when the mucosa is traumatised and inflamed. The tissue conditioner acts as a

cushion absorbing the occlusal loads, improving their distribution to the supporting tissues and encouraging healing of the inflamed mucosa.

2. **Temporary soft reline**: A short-term soft lining material can be used to improve the fit of a denture, typically an immediate restoration.
3. **Diagnosis**: A short-term soft lining material can be used as a diagnostic aid where the dentist wishes to check the reaction of the patient and the tissues to an improvement in fit of a denture.
4. **Functional impression**: A short-term soft lining material can be used as a functional impression material applied to the impression surface of a denture for the purpose of securing an impression under functional stresses.
5. **Recording the neutral zone**: The ability of these materials to be moulded by the oral musculature over an extended period of several minutes allows them to be used to record the neutral zone

Long-term soft lining materials

Long-term soft lining materials distribute stress more evenly under dentures than do the hard denture base materials. They also absorb impacts that can arise from masticatory function. They can therefore be said to have a shock-absorbing or cushioning effect. As a consequence, it has been shown that the addition of a long-term soft lining to a complete lower denture improves the ability to bite and chew and provides general improvement in comfort when compared with hard relines. The lining has also been shown to improve masticatory performance

Indications for use

1. **Persistent pain under a denture**.
2. **Thin atrophic mucosa**.
3. **Parafunction**.

It is useful to consider the first three indications together, as a complaint of persistent pain may be due to the poor quality of the denture-bearing mucosa or to the patient's inability to regulate gripping or grinding habits. It is important to make two points; **first**, the problem is almost always found in the lower jaw and, **second**, it is essential to ensure that all existing denture faults have been eliminated before deciding to proceed with a long-term soft lining.

4. **Replacing an existing denture which has a soft lining**. Once a patient has successfully worn a lower denture with a soft lining and has got used to its 'feel' it is often wise to repeat the prescription. If this is not done and the new denture is made with a hard base the patient may have problems in adapting to it and reject the prosthesis as a result.
5. **Sharp bony ridges or spicules**. The pattern of resorption of the mandible may result in sharp ridges or spicules of bone on which the denture-bearing mucosa. The problem might be overcome, at least in the short term, by surgically smoothing the bone. However, there are often occasions where poor health or a strong preference by the patient to avoid surgery are contraindications to this approach. There is also the danger that surgical interference with the mandible will speed up resorption of the bone. An alternative, conservative approach is to provide a soft lining, which often provides an acceptable level of comfort under these circumstances.
6. **Superficially placed mental nerve**. Another consequence of advanced resorption of the mandible is that the mental foramen and mental nerve may become superficially placed within the denture-bearing area so that the nerve is traumatised during function. This typically gives rise to a

complaint of a severe, sharp, stabbing pain from the area of the mental foramen which is brought on by biting. A soft lining restricted to the problem area may provide relief. However, it is not uncommon to find that a superficial mental nerve requires greater pressure relief than can be provided by a soft lining. If this is the case it may be necessary to cut the denture away in the area of the nerve to eliminate pressure on the nerve altogether.

Types of long-term soft lining

Soft linings are made either of ***silicone rubber*** or ***soft acrylic***. The silicone materials may be cold-curing or heat-curing. The soft acrylics are heat-curing; cold-curing soft acrylics have a very limited life span and are best thought of as temporary soft linings.

Aesthetics considerations in complete denture

Lec. 24 **د.صفوان عبد الحميد**

Aesthetics: the branch of philosophy dealing with beauty; in dentistry, the theory and philosophy that deal with beauty and the beautiful, especially with respect to the appearance of a dental restoration, as achieved through its form and/or color; those subjective and objective elements and principles underlying the beauty and attractiveness of an object, design, or principle.

Dental aesthetics: application of the aesthetics principles to the natural or artificial teeth and restorations

Denture aesthetics: the effect produced by a dental prosthesis that affects the beauty, attractiveness, character, and dignity of an individual. It is a combination of art and science of prosthodontics.

Factors Influencing the Appearance of Dentures:

- **A.** Patient factors
- **B.** Tooth factors
- **C.** Denture base factors
- **D.** Tooth/Denture base factors

A. Patient Factors

1. Sex
2. Age
3. Personality

Types of Tooth Positioning

1. Personality
2. Horizontally
3. Individual

B. Tooth Factors

1. Position
2. Colour
3. Size
4. Form.

Steps in achieving aesthetic complete denture:

1. An accurate impression
2. Jaw relation
3. Selection of teeth
4. Arrangement of teeth
5. Characterization

1. An accurate impression

Thickness of labial flange of both dentures, this is accomplished at the impression phase of treatment, so that the aesthetics as well as retention and stability are important goals. Border thickness should vary with the needs of the patient, depending on the extent of residual ridge loss. The vestibular fornix should be filled, but not overfilled, to restore facial contour.

2. Jaw relation

Amount of separation between maxilla and mandible, this is establishment of the correct vertical dimension of occlusion; proper vertical dimension of occlusion helps restore normal physiological length to muscles and allows normal facial expression.

Re-establishing the appropriate vertical spacing will improve the patient's appearance by decreasing the sunken and aging appearance. This vertical space must be not only aesthetically pleasing but also compatible with the typical mandibular joint apparatus, including the muscles of mastication.

3. Selection of teeth:

Teeth selection is very important as the selection of the appropriate shade, size, and form of the artificial teeth determines the aesthetic and function of the denture.

Objective of tooth selection:

1. Function efficiently
2. Normal speech
3. Aesthetically pleasing
4. No tissue abuses
5. Should maintain the vertical dimension.

• **Anterior teeth selection:** Anterior teeth selected primarily to satisfy aesthetic while posterior selected for function.

Guides for anterior teeth size:

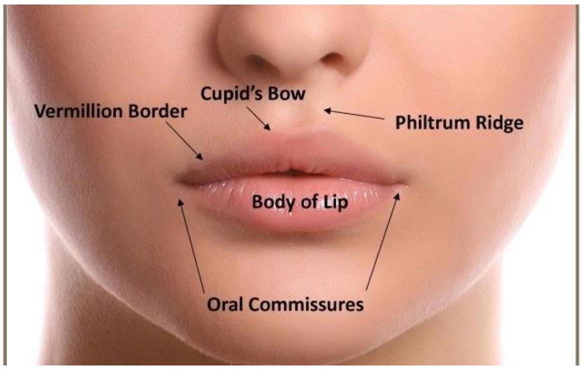
a. Pre-extraction records:

Diagnostic cast, photograph, radiograph, extracted teeth and previous denture.

b. Post extraction record:

1.Central incisors restore philtrum if possible.

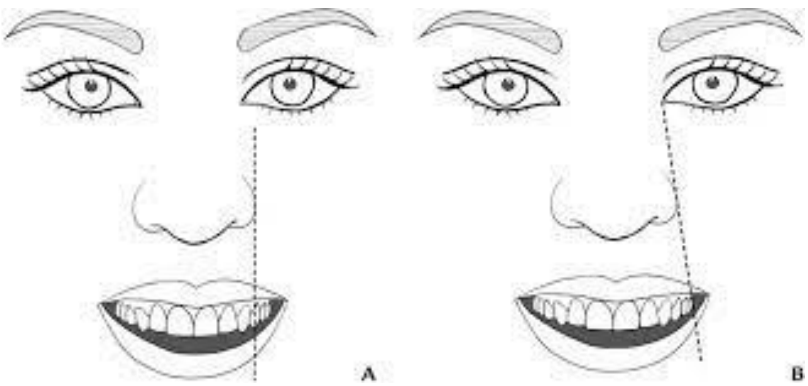
2.Central incisors restore vermillion border.



3.Incisal points and smile line determine height of tooth (age-related).

A. High smile line	✓ Showing more than 2mm of contiguous maxillary gingiva. 
B. Average smile line	✓ Revealing interdental papilla. 
C. Low smile line	✓ Displaying only the teeth without interdental papilla. 

4.Position of canine points



A. Relate to inter-alar width (smiling).

B. Relate to pupils (require pre-extraction photograph).

5. If patient is already a denture wearer, the mouth should be examined with the dentures in the mouth giving importance to physiological and aesthetic aspects.

Factors of selection of anterior teeth:

1. Colour

Show your patients a complete shade guide and select the two lightest and darkest tabs. Point out how different these two are and find out which one they prefer. Delete the rejected colour, and select another shade from the preferred half of the shade guide. Repeat this pair comparison, and after two or three selections by your patients, you will have the shades that they want. Note the selections used in your file.

2. Size: Depend on:

a) Existing dentures.

b) Models of previous teeth.

c) Photograph

Factors that influence the size of anterior teeth are:

1. Size of the face.

2. Amount of available interarch space.

3. Measured distance between distal of right and left maxillary cuspids.

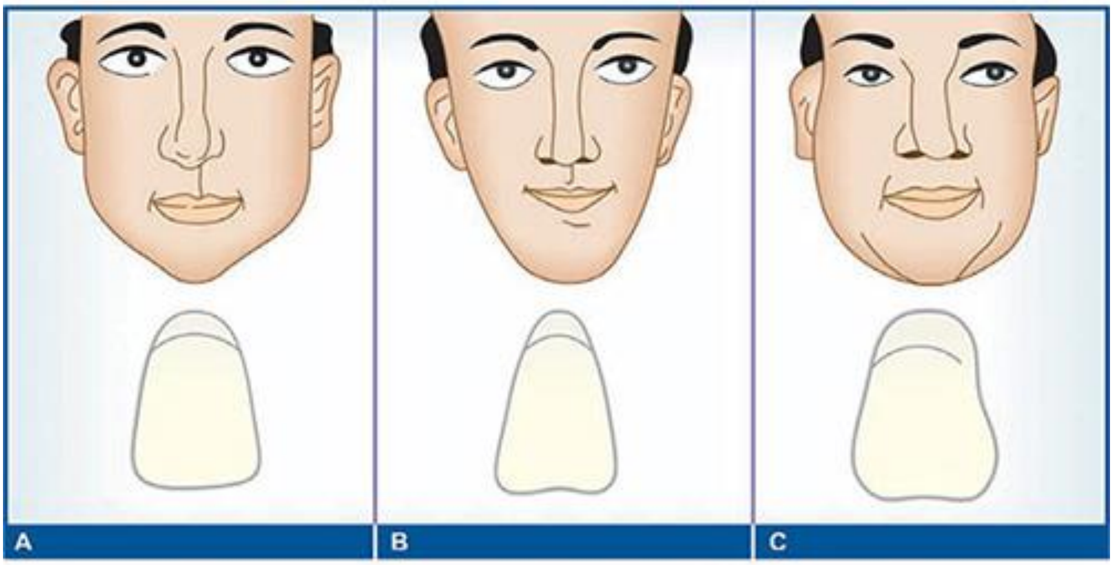
4. Length of the lip.

5. Size and relation of arches.

3. Mould

Select and agree on the mould of the teeth. Teeth of a similar size can appear entirely different because of their taper, contacts, and labial curvature. Allow your patient to select between moulds of the same size but different shapes. Set two different moulds on the right and left sides of a piece of wax rope and ask patients which they prefer.

There is a choice of mould: square, tapering or ovoid. In general terms, square moulds suit patients with large, rugged features. Long and narrow faces may be best suited to tapering moulds, whereas ovoid moulds tend to suit patients with small, round faces.



Form of the Anterior Teeth

The form or outline of the anterior teeth can be determined using the following factors:

1. Shape of the patient's face or facial form (previously mentioned)

2. SPA factors (sex, personality, age.)

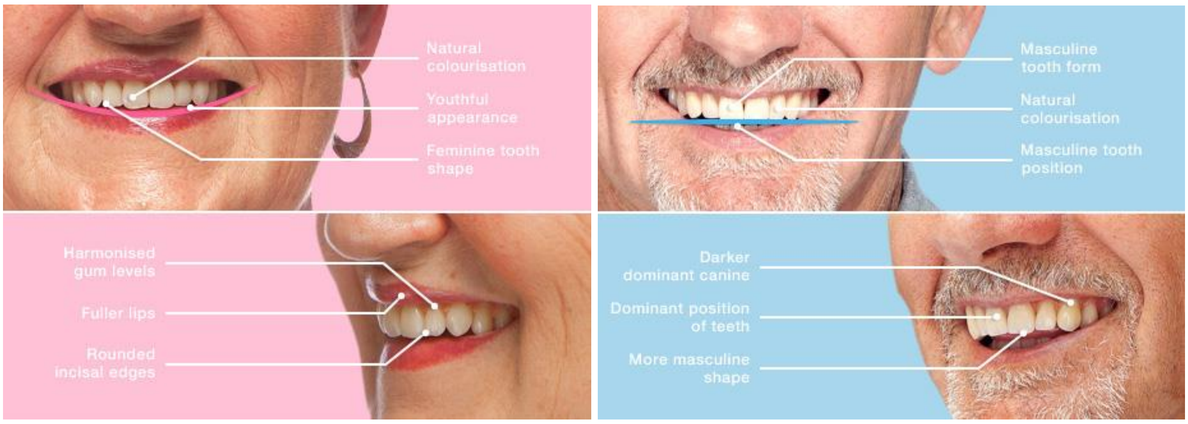
➢ **Sex:** The form or shape of the teeth differs in males and females. The differences in the shape of the anterior teeth in males and females are:

• **In females**, the **incisal angles** are more rounded and the teeth have a lesser angulation. **In males**, the incisal angles are rounded to a lesser degree and the teeth are more angular

• The **incisal edge of the central incisors** is parallel to the lips and the laterals are above the occlusal plane in males. But the incisal edges of the central and lateral incisors follow the curve of the lower lip in females.

• The **distal surface of the centrals** is rotated posteriorly for females.

• The mesial surface of the lateral incisors is rotated anteriorly in relation to the centrals in females



• In males **the mesial end of the laterals** is hidden by the centrals. This makes the canine very prominent in males

• Only the mesial thirds of the canines are visible in **females** because they are rotated anteriorly whereas even the middle two-thirds of the canines are visible in **males**.

• The **cervical regions are prominent** in males than in females.

• Females on **smiling expose more anterior teeth** hence, the premolars should be arranged based on aesthetics for females.

➢ **Age:**

The age of the patient is important in teeth selection because of the physiological and functional changes that occur in the oral tissues. The patient can be either young, middle-aged or old-aged. The following changes are observed with an advance in age of the patient:

• **Due to decrease in muscle tone**, **sagging** of the cheeks and the lower lips occur. To prevent cheek biting (due to sagging), the horizontal overlap of the posterior teeth can be increased.

• **Inter-occlusal distance reduces with age**. Hence, mandibular teeth are more visible than the maxillary teeth.

• Old people usually have **abraded teeth with worn out contacts**. Hence, placement of contoured teeth may look artificial.

• Old patients have **gingival recession**. It can be reproduced in the dentures to provide a natural appearance.

• Old people show a **blunt smile line** and **pathologic migration of teeth**.

• The **colour of the teeth also changes with age**. In old people, the enamel is abraded and the dentine which carries a yellow tinge, is more visible.

Additional clinical and technical considerations in anterior tooth selection patient preferences. A high smile line that displays a lot of gingivae would benefit from the selection of a less tapered mould with a long contact point. This minimizes the interproximal display of pink gingival acrylic, which is more difficult to make look more realistic than teeth. The resultant smile ends up being slightly more dental but with a less gingival display.

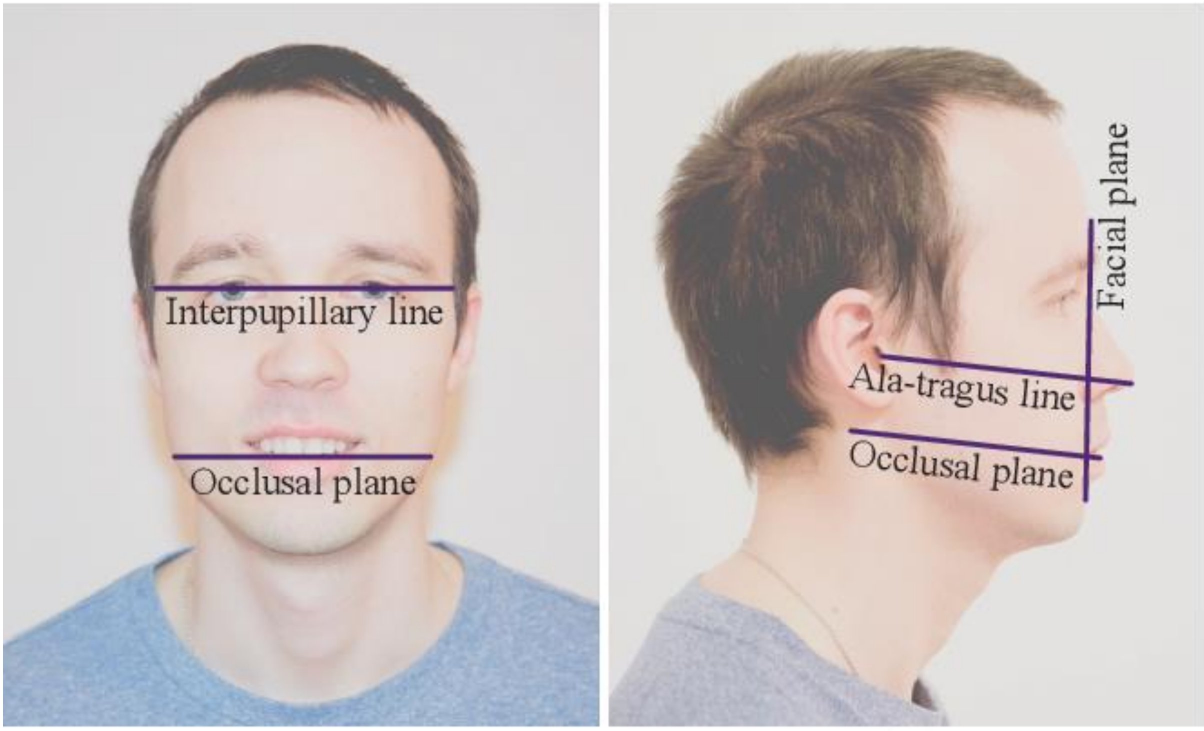
4. **Arrangement of teeth:** The goals of tooth arrangement are:

1. To have the front teeth look good.
2. allow the patient to speak clearly.

have all the teeth positioned for the best comfort, stability and retention of the dentures.

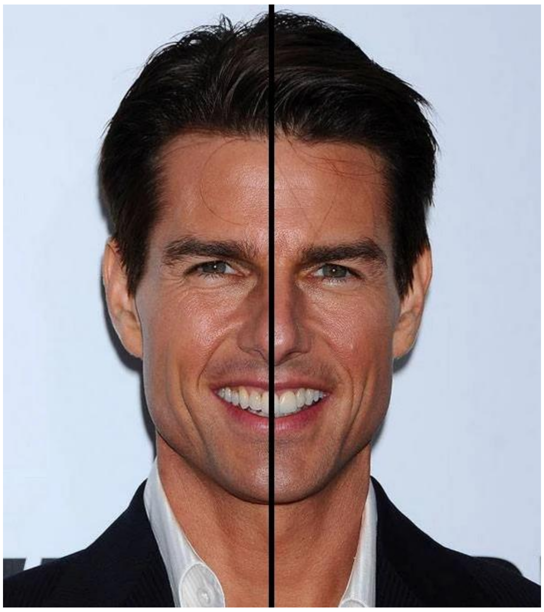
Position of the Teeth

The **amount of tooth showing**, **orientation of the occlusal plane**, and **labiolingual inclination** all have an influence on aesthetics. If the level of the occlusal plane is set too low, or if the anterior teeth are set on a flat plane, then the teeth will be too visible. This will be **emphasized when the patient smiles**, as the teeth will not follow the smile line of the lip. The **orientation will also have an influence**, and if is **not** approximately parallel to the interpupillary line, then the smile will look crooked.



(a) (b)

The **centre line of the teeth** is also critical, as this will have a negative effect on appearance if it is not coincident with the centre line of the face. The labial frenum should **not** be used to guide positioning of the centre line, as this is often not in the centre of the face.



The labiolingual position of the anterior teeth, in particular of the necks of the teeth, is critical in terms of lip support. A common misconception is that lip support is reliant on the shape of the labial flange of the denture. However, if the **flange is thickened**, then this will cause bulking out beneath the nose similar to a gum shield. If teeth are moved **away from the crest of the ridge**, then this will cause instability of the denture. Setting teeth **directly over the crest of the ridge** with an upright inclination will not provide adequate lip support. As previously discussed, the use of biometric guides to place the teeth where the natural teeth used to be can improve aesthetics dramatically. A further possibility is to place the necks of the teeth close to the alveolar ridge and tilt the incisal edges of the teeth labially. This will improve the lip support and is less likely to be unstable than when using biometric guides.

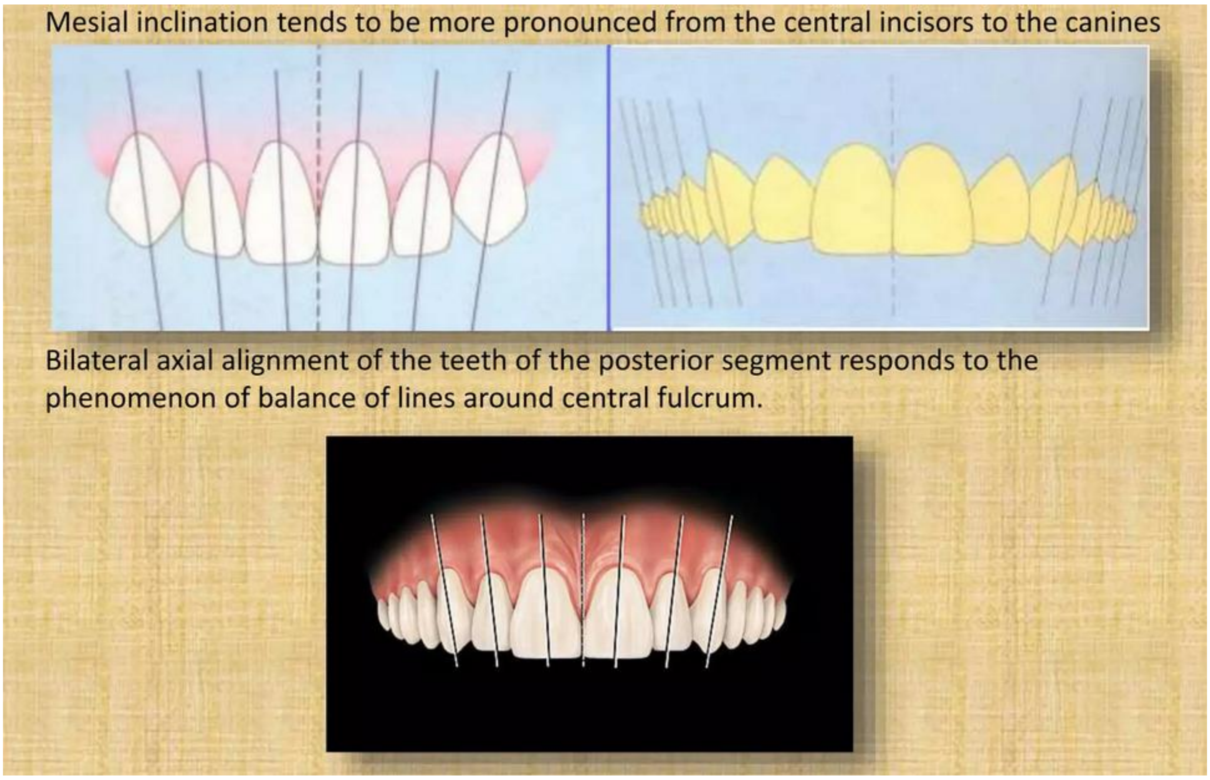
Arrangement of teeth with aesthetics consideration

The clinician should attempt to create the illusion of natural teeth when finalizing the appearance. It should be remembered that the prevalence of irregularity or crowding of natural teeth is high.

Therefore, if dentures are constructed with a 'perfect' arrangement, the risk of the resulting appearance seeming artificial is considerable.

As a general rule, imperfection in the anterior tooth arrangement is a basic requirement in creating the illusion of natural teeth. Complete symmetry should be avoided: for example, the anterior teeth should not be placed so that the incisal edges are all at the same level.

The vertical axes of the anterior teeth can be varied, but if the inclination of these axes on one side of the mouth does not approximately balance that on the other, an unsatisfactory appearance will result.



Arrangement of the lower anterior teeth

In many patients, they will be displayed more during function than the upper teeth and therefore may be a dominant factor in determining the patient's dental appearance. Again, the same general rules regarding perfection and evenness of tooth arrangement which have been discussed previously should be applied. The following should be considered when arranging lower anterior teeth:

1. Vertical overlap.
2. Horizontal overlap.
3. Antero-posterior inclination in proximal view.
4. Inclination of long axes.

Incisal relationship

The method of determining an incisal relationship which is appropriate for an edentulous patient's skeletal relationship is important. If a patient is provided with dentures which have an inappropriate incisal relationship, for example, a Class I incisal relationship on a marked skeletal Class II base, there is a risk that, in addition to **problems with stability**, the **dentures will lack in harmony** and the **aesthetic result will be poor**.

The Gingival Contour:

There are **three** aspects to consider:

1. the **contour of the gingival margins at the necks of the teeth**.
2. the **contour of the flange**.
3. the **colour of the flange**.

In a natural dentition, the contour of the gingival margin varies from central incisor to lateral incisor to canine. This should be reproduced in a complete replacement denture. In terms of the shape of the flange, the clinician must decide whether to provide a flange with a smooth or anatomical finish. In the **case of the anatomical finishing**, the dental technician is instructed to:

1. Reproduce the **shapes of the roots of teeth** when contouring the flange.
2. The **flange can also be stippled** to reproduce stippling of the keratinized gingiva. These features are most useful when the patient has a high smile line and is likely to have a visible flange. A potential **problem with anatomical contouring is the difficulty in keeping the flanges clean**, particularly when extensively stippled.
3. Finally, the appearance of the oral mucosa can be reproduced using colour tints in the acrylic resin. This is time consuming for a dental technician and will be facilitated by the technician seeing the patient or a photograph of the oral mucosa. Nonetheless, the appearance of the denture will be enhanced if the flange is visible due to a high smile line.

Anatomical features reproduced in the appearance of a denture flange.

Denture base factors:

1. Contour
2. Colour

Benefits of properly contoured dentures:

- Improved tolerance and comfort
- Facilitates stability and control.
- Prevents chronic biting of the lip or cheek.

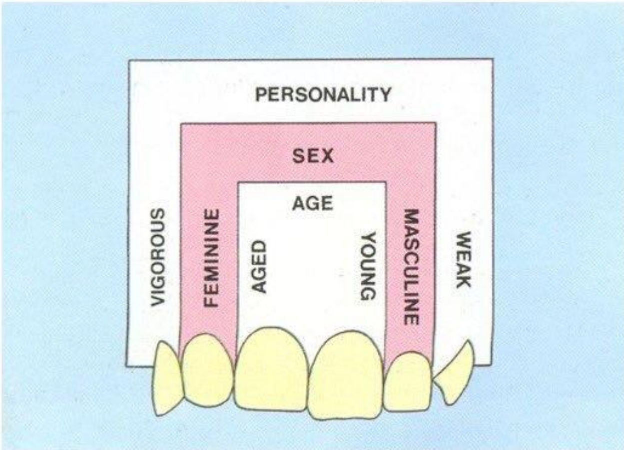
5. Characterization

To alter by application of unique markings, indentations, coloration and similar custom means of delineation on a tooth or dental prosthesis thus enhancing the natural appearance.

Characterizing the dentures without deviating grossly from the principles of teeth setting to suit the individual's appearance. The possible effect is that all dentists may give almost identical complete dentures to their patients. All complete denture wearers were looking similar possessing a monotony of sameness. They understandably do not ask for what they don't know. It is the duty of the dentist to inform the patient that his/her complete denture can be characterized to suit his/her wish and appearance. Characterization helps the dentist to incorporate his artistic skills along with theoretical knowledge in the fabrication of denture. Size and shade of the teeth can be selected to match the patient's natural teeth. The aim is that the teeth should harmonize with the facial features, and it should be functionally acceptable. **Characterization** should have some amount of realistic perception rather than incorporating unrealistic features.

According to **Frush** and **Fisher** dentogenic concept includes effects of **three** main factors such as **age**, **sex** and **personality** in sequence of aesthetic planning. Various means like minor irregularities in tooth arrangement, overlapping, tilting, depth grinding, modification of incisal edges, rotations of teeth, stippling, staining, tinting of the denture base, crowding and fixing dental jewellery etc., can be incorporated.

Dentogenic concept



Final Decision for Aesthetics depends upon:

• Maxillomandibular relationships

• Patient’s appearance

• Patient’s mental attitude

• Functional requirements

Immediate denture

Lec:9-10 د.صفوان عبد الحميد

Introduction:

There are different treatment options for a patient facing loss his/her remaining natural teeth, immediate denture is one of these options that fulfil an important role in today's treatment modalities by providing the patients with aesthetics, function, and psychological support after extractions and during the healing phase.

Definition:

An immediate denture is "***any complete or partial removable dental prosthesis fabricated for placement immediately following the removal of natural teeth***".

It may be either single immediate dentures or upper and lower immediate dentures in the same patient. The latter should be made together to ensure optimal aesthetics and occlusal relationships.

Indications:

1. Educated patient with daily social activity (doctors, lawyers and teachers).
2. Hopeless remaining teeth (caries, periodontal diseases or malocclusion)
3. patient with stable health condition.
4. Patient don’t mind some additional visits or cost.

The best patient for immediate dentures is the ***philosophical type***. Their motivation for denture is the maintenance of health and appearance, and they accept replacement of natural teeth that can’t be saved as normal procedure.

Contraindications:

1. Patients who are in poor general health (systemic diseases).
2. Patients who are identified as uncooperative, indifferent and unappreciative.
3. Patient at risk from bacteraemia.
4. Patient with recurrent history of post extraction haemorrhage.
5. The presence of acute periapical or periodontal diseases and extensive bone loss.
6. Patient don’t mind being edentulous for a period of time till complete healing.

Advantages:

1. Maintenance of a patient's appearance because there is no edentulous period.
2. Circumoral support, muscle tone, vertical dimension of occlusion, jaw relationship, and face height can be maintained. The tongue will not spread out as a result of tooth loss.
3. Less postoperative pain is likely to be encountered because the extraction sites are protected. Some authors have discussed whether immediate dentures reduce residual ridge resorption.
4. It is easier to duplicate (if desired) the natural tooth shape and position, plus arch form and width.
5. The patient is likely to adapt more easily to dentures at the same time that recovery from surgery is progressing. Speech and mastication are rarely compromised, and nutrition can be maintained.
6. Overall, the patient's psychological and social well-being is preserved. The most compelling reasons for the immediate denture prescription are that a patient does not have to go without teeth and that there is no interruption of a normal lifestyle of smiling, talking, eating, and socializing.

Disadvantages:

Immediate dentures are a more challenging modality than complete dentures because the presence of teeth makes impressions and maxillomandibular positions more difficult to record.

Specific disadvantages include the following:

1. The anterior ridge undercut (often severe) that is caused by the presence of the remaining teeth may interfere with the impression procedures and therefore preclude also accurately capturing a posteriorly located undercut, which is important for retention.
2. The presence of different numbers of remaining teeth in various locations (anteriorly, posteriorly, or both) frequently leads to recording incorrectly the centric relation position or planning improperly the appropriate vertical dimension of occlusion. An occlusal adjustment, or even selective pre-treatment extractions, may be needed to make accurate records at the proper vertical dimension of occlusion.
3. The inability to accomplish a denture tooth try-in in advance on extractions precludes knowing what the denture will actually look like on the day of insertion.
4. Because this is a more difficult and demanding procedure, more chair time, additional appointments, and therefore increased costs are unavoidable.
5. Functional activities such as speech and mastication are likely to be impaired however this is a temporary inconvenience.

Types of immediate dentures:

According to the case and type of treatment plan, immediate denture may plan to be:

1. Conventional (or classic) immediate denture (CID):

It is an immediate denture, which can be later modified to serve as the permanent prosthesis. It is usually done for patients undergoing total extraction. The treatment outline while preparing a conventional immediate denture consists of the extraction of the posterior teeth followed by the extraction of the anterior teeth. The ridges in the posterior region are allowed to heal before the extraction of the anterior teeth. The denture is inserted on the appointment of extraction of the anterior teeth. After this the denture is refitted or relined to serve as the long-term prosthesis.

2. Interim (or transitional or non-traditional) immediate denture (IID):

Interim denture is defined as, "A dental prosthesis to be used for a short interval of time for reasons of aesthetics, mastication, occlusal support, or convenience or to condition the patient to the acceptance of an artificial substitute for missing natural teeth until more definitive prosthetic therapy can be provided".

These are immediate dentures used temporarily, during the healing period of the patient to preserve ridge contour, until the permanent denture can be fabricated. They are mainly indicated in patients with periodontal disease going in for total extraction. They help to preserve the contour of the ridge until a permanent denture can be fabricated.

CID	IID
Definitive	**Transitional**
Intended as the final or long-term prosthesis	Intended for short term use only
After healing, it is relined with acrylic resin	After healing, a second denture is made
Indicated when two extraction visits are feasible	Indicated when only one surgical visit is preferable to maximize insurance benefits
The aesthetics of the denture cannot be changed	The second denture procedure allows an alteration of aesthetics, and all other factors, if indicated
At the end of treatment, the patient has one denture	At the end of treatment, the patient has a spare denture to use in case of extenuating circumstances
If all posterior teeth are initially removed, vertical dimension of occlusion is not preserved. (However, opposing bicuspids can be maintained)	Since posterior teeth need not be removed, vertical dimension of occlusion may be preserved
Contraindication for patients who will need complicated treatment plans involving both arches, such as periodontal therapy, crowns and fixed, partial dentures and dentures opposing removable partial dentures	Often indicated when the patient will become edentulous in one arch and partially edentulous in the opposing arch for the first time. An interim complete denture can be made. Then any periodontal procedures, crowns and fixed, partial dentures, can then be done during the initial healing stage

Immediate denture can be classified according to type of restoration into:

1. Immediate complete denture.
2. Immediate partial denture.
3. Immediate over denture.

However immediate denture is probably better described by the more appropriate term of transitional dentures. This term is more appropriate because the day that the last teeth are removed and the dentures placed is the beginning or transition from natural teeth to denture teeth.

The transitional denture has three or four phases." The **first phase** is preparatory extractions of all posterior teeth in the arch to receive the denture. All molars and bicuspids are removed and the bone and overlying gums are allowed to heal. Sometimes Upper and lower first bicuspids are left to keep the bite dimension from changing as well as provide a broader smile during healing. The healing period varies but is usually six to eight weeks. Some patients will have transitional removable partial dentures made to replace the back teeth. These partial dentures are used only during the healing of the posterior areas phase. They can be placed the same day the back teeth are removed and will require some adjustments for fit and function during healing. Use of transitional removable partial dentures is not always possible so each case must be determined on an individual basis.

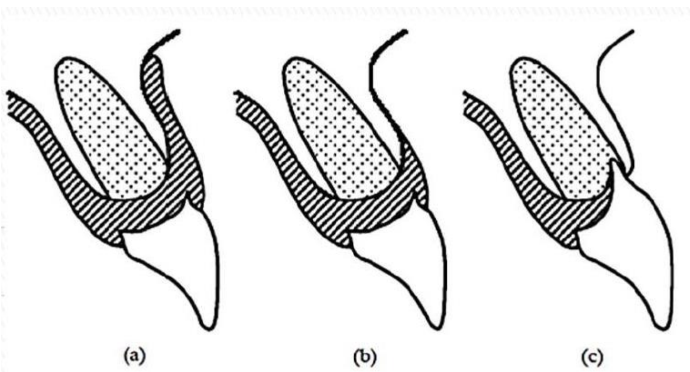
According to flange design:

1. **flanged type.**

a. complete flange.

b. partial flange.

2. **Open-faced flangeless type (open face or close fit).**



Types of immediate denture: (a) complete flange; (b) partial flange; (c) open face.

Comparisons of flanged and open-faced denture:

1. Appearance of flanged denture does not alter after fitting where the appearance of open – face denture (although good initially) can deteriorate rapidly as resorption create a gap between the necks of the teeth and ridge.
2. The flanged denture allows freedom in the positioning of teeth, where, in open face denture teeth have to be positioned in the sockets of the natural teeth; So, on case of malposition teeth, we can do good alignment in flanged denture while we cannot in open face type.
3. In upper denture:

   A flange on an upper denture creates a more effective borders seal, therefore, better retention is achieved with an open face denture.
4. In lower denture:

   Open face denture is not usually constructed because of poor stability of lower denture during function, so flange denture is commonly used. So, flange denture is better from the point of stability.
5. The presence of labial flange produces a stronger denture, labial flange will make the denture stiffer so the midline fatigue fracture caused by repeated flexing across the midline is reduced. So, from the point of strength the flange denture is better.
6. As the bone resorbed following extraction the denture become loose and a reline is required, so the presence of labial flange make it easier to add either a short–term soft lining materials or a cold curing relining materials as a chair side procedure, as the colour of some reline materials is not always ideal, they may be visible when used with open face denture.
7. The flange denture covers the clot completely and protect them more effectively, the flange denture exerts pressure on both lingual and labial gingiva reducing post extraction haemorrhage.
8. The consequence wearing of ill-fitting denture can lead to:

a. If it is open face, will produce a scalloped ridge in the region of the socketed teeth.
b. In flange denture, distribution the functional loads more favourably to the underlying ridge, thus minimizing bone resorption.

9. When patient have got used to an open face immediate denture there is difficulty to accept a denture with labial flange in future and patient will complain from the fullness of the lip. If flange denture had worn from the beginning this problem does not occur.
10. When the ridge morphology produces deeply undercut area it may not be possible to fit a full labial flange unless there is surgical reduction, in this case the using of partially flange denture or open face denture is preferable when surgical procedure is contraindication.

Explanation to the Patient Concerning Immediate Dentures:

1. **They do not fit as well as complete dentures.** They may need temporary linings with tissue conditioners and may require the use of denture adhesives.
2. **They will cause discomfort.** The pain of the extractions, in addition to the sore spots caused by the immediate denture, will make the first week or two after insertion difficult.
3. **The aesthetics may be unpredictable**. Without an anterior try-in, the appearance of the immediate denture may be different from what you expected.
4. **Many other denture factors are unpredictable such as the gagging tendency**, increased salivation, different chewing sounds, and facial contour.
5. **Immediate dentures must be worn for the first 24 hours without being removed by the patient.** If they are removed, they may not be able to be reinserted for 3 to 4 days. The dentist will remove them at the 24-hour visit.

6. **Because supporting tissue changes are unpredictable**, immediate dentures may loosen up during the first 1-2 years, or 4-6 months depending on the No. of teeth and their location.

Diagnostic steps:

- Good oral hygiene is essential before starting any prosthodontic treatment.
- Patient's systemic condition, it is very important to check the general health of the patient because multiple extraction may not be tolerated by all the patients, that's why patients with uncontrolled systemic diseases should not be included in this type of treatment. Patients under medical control and do not interfere with the steps of denture construction including several teeth extraction with or without some surgical corrections can be included, medical consultation is advisable.
- Full dental history must be recorded in the case sheet.
- Periodontal condition of the remaining teeth must be assessed, this must include teeth mobility, measurement of the pockets; because this might affect surgical step of the treatment course. Severe case of periodontal disease may suggest some surgical correction after extraction to have well contoured residual ridge covered with firmly attached mucosal tissue. Periodontal condition may give a primitive assessment about the bone remodelling subsequent to the surgical phase.
- Full teeth charting, teeth my help in retention as a partial denture or overdenture abutments must be determined, any soft or hard tissue correction as frenal release or bone reduction must be included after good evaluation.
- Radiographic examination

  Which is essential for immediate denture patients. Periapical radiograph may be useful for localized area; OPG view give general view for both jaws in single image.

- Teeth mould and shade must be recorded, proper communication with the patient about his teeth shade and form is essential, furthermore teeth alignment and any individual variations as diastema, spacing, rotation of the teeth if the patient like to preserve same appearance or improvement could be suggested by dentist for better appearance. **But** it is very important to remove any premature contacts because these may interfere with correct jaw relation record, essential changes to improve occlusal plane, midline, overjet and overbite and any other corrections that help in aesthetic and functional requirements.
- Occlusal plane adjustment is necessary because the factors that necessitate tooth extraction are often associated with occlusal discrepancies. These also interfere with centric relation record as well as with the proper determination of occlusal vertical relation. Proper location of low and high lip lines must be determined to determine the required changes in teeth position or angulations.
- Presence of any infection or inflammation in the soft and hard tissues. Periapical abscess, granuloma and cysts may make the· estimated tissue changes at the time of extraction and healing and remodelling process unpredictable; this may increase of the risk of unfitted immediate denture.
- Previous prosthesis, (if present) must be checked as an additive reference for the jaw relations or teeth selection. It also may help the dentist to explain some of treatment or correct some errors.
- In many cases of immediate denture construction, diagnostic casts are essential. These casts could serve a lot in the treatment plan and communication with the patient. the casts also can be used as a pre-extraction record.
- All immediate denture patients must have good oral prophylaxis, proper scaling and good oral hygiene, this will reduce postoperative oedema and

infection. Other treatments as restoration crown and bridges or even RPD all must be one coincidence with immediate denture planning.

In the diagnosis step; with all the collected information you have to decide type of surgical procedure, immediate denture can be constructed with one of the surgical procedures:

1. Extraction of teeth only.
2. Extraction of teeth with alveoloplasty.

In some case simple corrections may be needed at the sight of extracted teeth to improve the shape of the alveolar process in order to facilitate and improve denture objectives. In these cases, surgical splint construction is important. This splint usually constructed on the master cast after teeth trimming. Cases with excessive bone correction may be end up with rapid bone resorption and unfitted denture, therefore bone removal must be conservative. Consultation with the surgeon is essential in some cases.

Impression:

Successful primary impression is governed by proper stock tray selection, proper material selection and manipulation (usually irreversible hydrocolloid material is used) and well-trained dentist to handle and make the impression in a proper technique.

- Stock tray metal or plastic must extend to cover the intended denture bearing area able to record the vestibule extension, it must cover the retromolar area in the lower arch and extended posteriorly to include tuberosity and hamular notch in the upper arch. Enough space between the tray and the oral tissue to have enough and uniform thickness of the impression material; this does not mean to use oversized tray because it distorts the tissue and recording procedure. Wax sheet may be used to complete minor under extension. The impression must be free of voids fully extended according to the planned prosthesis design.

- In some cases when the remaining teeth are very loose, there is a risk of teeth extraction during impression making, so try to fix these teeth either by:

1. applying a lubricant medium to the teeth.
2. in case of adjacent teeth to each other's applying moulding soft wax into sub-contact point spaces and around the necks of teeth so that the impression material is prevented from locking into the undercuts.
3. in case of solitary tooth placing a loose-fitting cupper band over the tooth before taking impression.
4. placing holes in the tray and using an amalgam condenser to release the tray over the loose tooth.

The primary impression:

May be useful as a final impression in case of immediate single tooth replacement with or without short span partially edentulous arch.

- Primary cast is delivered by pouring the primary impression with any of the gypsum products.
- This cast helps as a study cast to plan the sequences of the treatment as well as used to construct special tray.
- surveying, undercuts block out and relief must be done on the cast.

The Final impression:

Different tray design and impression techniques were described to deliver final impression, these techniques may range from simple to more complicated depend on tray design and material used.

Selection of a suitable technique depending on:

- **a.** Case difficulty.
- **b.** Number and location of teeth included in the immediate denture treatment.
- **c.** Teeth and tissue undercut.
- **d.** Type of the planned surgical operation, impression material.
- **e.** Dentist skill and experience.

The imperative technique is that record the tissues and denture bearing area in a maximum accuracy that minimize the insertion, post-extraction denture adjustment and maintenance phases as possible.

Special tray is constructed on the primary cast, cold cure resin is a suitable material.

Final impression may be taken by:

Single full arch custom tray:

- This technique can be used for conventional immediate denture and the only tray used for interim immediate denture.
- Also, it is used when the patient has anterior teeth only or anterior and posterior remaining teeth.

❖ Technically; first of all, on the primary cast outline the tray extension to be shorter than the vestibular depth by 2 mm and include the posterior limit.

❖ The remaining teeth must be covered with single layer of sheet wax; then second layer is used to cover all the area needed to be recorded by the impression and covered with the denture; this technique usually used in conventional immediate denture while in interim immediate denture all the teeth and denture foundation area are blocked using two layers of wax. Tissue undercut must be blocked properly to facilitate tray removal.

❖ A stops effect is provided by making 4-5 regular holes through the wax, symmetrically distributed anteriorly and posteriorly.

- ❖ Finally adapt the cold cured acrylic resin dough layer to fabricate the special tray; ensure proper extension and stops holes are filled with acrylic. The handle can be placed on the anterior area as usual or you may place it in the mid of the palate to prevent over lengthening of the tray in the anterior area might interfere with impression making.
- ❖ Allow the resin to set; then remove the tray and reduce excess material, finish and smooth the borders and surfaces. Proper perforations must be done symmetrically -as possible- or using adhesive depending on used impression material.
- ❖ This technique can be used when the anterior teeth are remaining only or when anterior and posterior teeth are present.
- ❖ Now check the tray in the patient's mouth and do border molding by using tracing compound; in the same manner as in conventional complete denture and continue to do final impression.
- ❖ You may use irreversible hydrocolloid or polyvinyl silicone or polysulfide rubber base or polyether as a final impression material. More expert dentist may use 2 impression material in one tray for maximum accuracy.

Sectional impression tray OR split impression tray technique

- Use two trays or sectional custom tray.
- This technique is used in conventional immediate denture only; and cannot be used in interim immediate denture.
- It involves construction of two trays on the same cast one for the posterior region made as in complete denture and the 2nd is constructed for the anterior region backless tray indices or references must be made in the tray.

Procedure:

- ❖ Outline the tray extension in the same manner as in 1st technique.
- ❖ Block all tissue undercuts and interdental spaces.

- ❖ Use proper separating medium then adapt the cold cured resin mix to the posterior edentulous area and extend it to cover the lingual surface of the anterior teeth beyond the incisal edge then put the handle.
- ❖ For the anterior region; you may use:

▪ construct a custom tray to cover this area only. Alternatively, the impression material may be carried to the mouth in a second sectional tray that is indexed to the primary tray. In either case, the anterior section impression will capture the facial anatomy of the teeth, the vestibular anatomy, and indices on the primary impression/tray. Upon removal of the anterior and posterior sections separately, the two sections are reassembled outside the mouth (using the indices) and prepared for casting.

▪ you may adapt and cut a plastic stock tray to fit the anterior section.

▪ expert dentist prefers not to use a tray but they use a heavy mix of elastomeric impression material in the mouth.

- ❖ The anterior section of the impression must record the labial aspect of the teeth as well as the vestibular area.
- ❖ To make the impression, the posterior sectional tray (must be tried for proper extension, border moulding is made with tracing compound) as in conventional complete denture, then final impression for edentulous area is made by using zinc oxide eugenol impression material or polyvinyl silicon or polysulfide or polyether, you can use non-elastomeric impression material here.
- ❖ The most important thing in sectional impression tray is the accuracy and proper seating of the trays and reassembling both. Care must be taken not to distorted this assembly during tray removal from the mouth or during pouring therefore it's advisable to bead and box the impression before pouring.

- ❖ Modification of the above technique can be made as to make a full tray covering the denture bearing area with a hole opposite to the teeth area, again we do border mouldings and impression then a proper stock tray over the custom one can be used to capture the teeth area with alginate material.
- ❖ Finally, when you remove the impression from patient's mouth it will record the whole denture bearing area made by two different materials.
- ❖ This technique is used mainly when the posterior area is edentulous and only anterior teeth are remained and need to be replaced with immediate denture.

Note: the projections on the external tray surface serve as indices.

- ❖ It is also possible to use special tray instead of stock tray but it is essential to put the indices or references to ensure reassembling.
- ❖ The final impression must be poured with stone to get the master cast; this cast is used to prepare the record base and the occlusion rim.

Beading and boxing:

All the impression must be beaded before pouring. Wax may not stick to the alginate impression material; therefore, care must be taken to insure proper beading. Once you fix beading wax, boxing wax sheets can be easily stick to the impression. In the sectional impression, be careful to seat the sections properly on the indices. Pour the impression and remove the tray as in the conventional manner.

Record base and occlusion rim:

Bite rim usually constructed to record jaw relations

▪ If the patient has enough number of remaining anterior and posterior teeth no need for record base or bite rim as in most of interim immediate denture.

▪ while if there isn't enough number of remaining teeth as in all of conventional immediate denture and some of the interim immediate denture cases; bite rim must be constructed.

▪ Before constructing the record base, all teeth and tissue undercuts must be blocked by wax, then cold cure acrylic dough is applied on the edentulous area of the cast. When the material set, record base must be finished and polished; final evaluation must show a stable properly extended record base.

▪ Wax occlusion rim is added to the corresponded edentulous area on the base. Levelling of the wax must depend on some anatomical landmarks as the retromolar area and you may use the remaining teeth but not always.

▪ Record base extension and wax rim height must be evaluated clinically. Lip lines; high and low must be determined and marked on the cast, in this way any correction or modifications can be done or marked on the cast to be considered in the teeth setting.

Jaw relations record:

Include vertical and horizontal relations, these usually made as in the conventional denture construction.

▪ If we have vertical stops between two opposing posterior teeth, these relations are maintained unless further corrections are needed to improve aesthetic or function.

▪ Evaluation of the existed vertical dimension of occlusion must be accomplished and dentist must decide if this going to be restored or modified.

▪ Uneven tooth loss, teeth wear, loosening of the remaining teeth drifting and extrusion all may indicate correction of vertical relation.

▪ The occlusion rim and sometimes remaining teeth must be adjusted for correct occlusal vertical dimension.

▪ In the immediate complete denture; leave first premolars bilaterally to maintain vertical and horizontal relations and facilitate recording of the jaw relations.

▪ In this visit dentist must record the midline, canine lines, ala-tragus line, smiling and high lip line, anterior occlusal plane in relation to the remaining teeth.

▪ Face bow transfer and centric Jaw relation must be recorded.

▪ Once you record vertical and horizontal relations you are ready to mount the cast on a suitable articulator.

▪ Selection of artificial teeth, acrylic teeth are the recommended type.

▪ Consider all parameters in teeth selection, in the anterior and posterior segment. Shade, Size, form, an occlusal form of posterior teeth must be selected to fit each case specifically.

▪ Arrangement of posterior teeth done in the same way as in the conventional complete denture, maintain proper occlusal plane.

Try-in

▪ In this way you set the posterior or anterior missing teeth to try it in the patient's mouth check and verify occlusal plan and jaw relations in the try-in step.

▪ Try in step is not possible in every immediate denture case but even so mounting of the master casts must be confirmed in patient's visit.

▪ In most of conventional immediate denture cases posterior teeth are missed so you can set the posterior teeth as in conventional complete denture construction following the rules of teeth arrangement in the centric occlusion.

▪ The trial denture now must be tried in the patient's mouth and verify the vertical and centric relations.

▪ If errors can be detected in the centric relation, lower cast must be remounted after a new record and teeth must be reset.

▪ Confirm all the landmarks recorded in the diagnostic step to set the patient's desire as:

- ❖ The midline weather it is the same or verified but it is very important to inform the patient if you decide any change prepare yourself to explain the reasons for the patient.
- ❖ The anterior plane of occlusion; teeth may be extruded-or over erupted so correct plane of occlusion must be recorded on the casts. Use some of the anatomical landmarks interpupillary line and parallelism with the ala-tragus line.
- ❖ High lip line must be determined and marked on the cast. Discussion must be made with the patient about the amount of display of the teeth and gingiva.
- ❖ Localized alveoloplasty or some changes in the teeth alignment may be suggested to improve appearance. Make sure that the patient sees and approves this.
- ❖ Diastema, rotated teeth, overjet and overbite and other natural variations must be discussed with the patient because some patient may ask for a perfect looking even if they never had, others may like their natural variations (in this way nobody can notice the denture). Dentist may share his experience, knowledge and opinion for best results especially when the patient asks for changes or variations interfere with function and aesthetic principles. The patient must be actively involved in the decisions of aesthetics.
- ❖ Always re-evaluate final result after every changes.

▪ All the required change must be recorded on the cast as well as on the case sheet.

▪ In this visit further information about the following must be given, Surgical procedures, tissue changes as oedematous and discoloration few days after insertion, local sense of lip puffiness even when the oedema dissolved due to the flange extension.

▪ Answer all the questions asked by the patient directly and very clear.

▪ At the end of the try in visit you have to check all what is related to the present teeth and mark all what you have to change- teeth and tissues.

Cast trimming:

▪ The remaining teeth now must be trimmed to be replaced with artificial teeth.

▪ Trimming of the cast must be done carefully to estimate as possible the shape of the residual ridge after teeth extraction.

▪ Final cast ridge must be similar to the couture of the foundation area after teeth extraction.

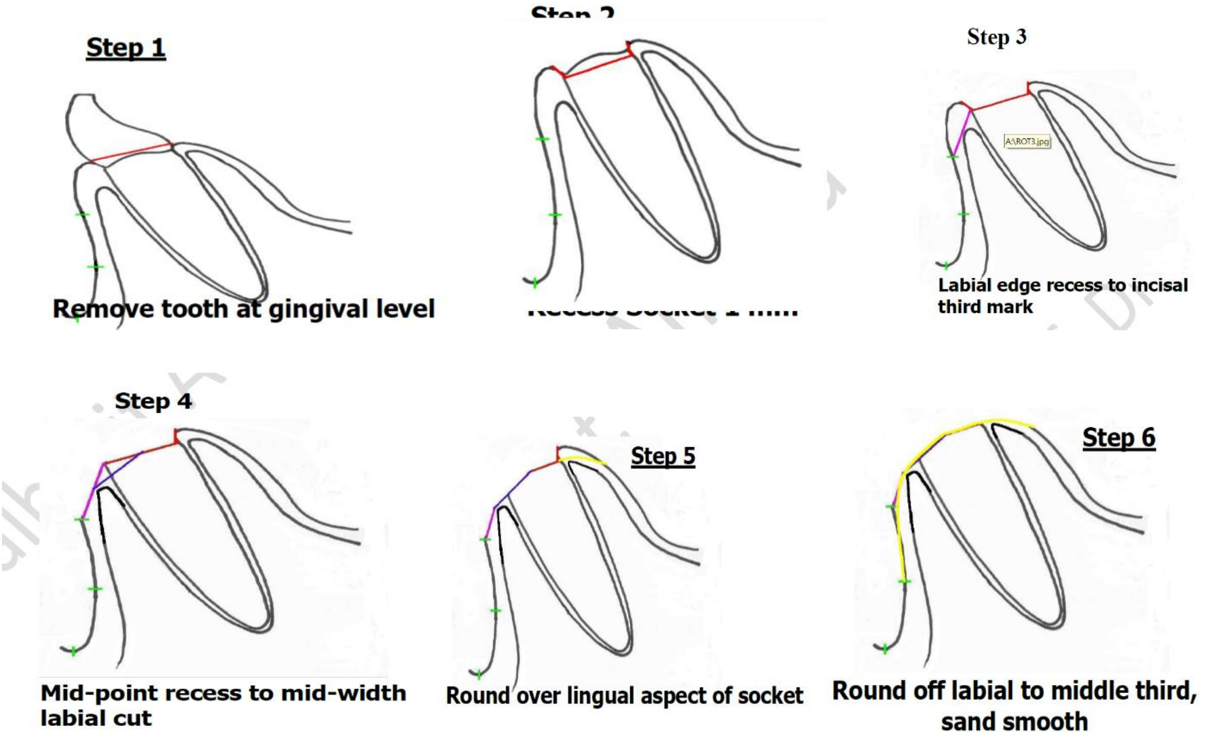
▪ More than one method may be use to trim and set the teeth in immediate denture cases.

It depends on:

1. If you decide to duplicate same teeth alignment or not.
2. Aesthetic and functional requirement.
3. Amount of changes expected during surgery.

Usually, teeth are trimmed by using a saw or disc bur sharp knife or wax knife may help. Scribe guidelines on the cast recording the position, angulations and incisal level of the natural teeth (In this step it must follow the rule of third to guide cast trimming).

Steps of trimming are:



▪ Note that the amount of grinding is very minimal on the palatal side, this is because the remodelling after extraction is usually minimal in this side.

▪ Final ridge form must be round and continuous from the buccal and lingual surfaces.

▪ Cast trimming may be done at same time of teeth arrangement.

▪ Do not change or trim the essential landmarks as incisive papilla or any frenum.

Waxing and flasking:

▪ Generally immediate denture is thinner than the conventional CD especially in the anterior, but be careful at time of insertion and in the presence of undercut the acrylic must be thick enough to be adjusted.

▪ In this step you have to custom any selected personalization criteria must be carved.

Surgical splints:

- After complete cast trimming, surgical splint must be constructed

- It is a thin transparent form of tissue surface of the immediate denture; it is used to guide the surgical shaping of the alveolar process.

- It is essential when there is a need to do some alveolar corrections after teeth extraction or ridge recontouring or correction of the inter septal bone or in multiple teeth extraction.

  - Make alginate impression on the cast after trimming.
  - Pour the impression (cast duplication).
  - Make the clear template processed either by heat or light ,vacuum form and sprinkle-on method can be used also.

- Advantage: Splints also help to remove any expected pressure area at the sight of extraction thus minimize insertion time and adjustment at the insertion time.

Setting of anterior teeth:

Arrangement of anterior teeth can be made in different ways; we have to decide:

1. If the teeth are need to be changed in location or alignment to improve the aesthetic.
2. The teeth are well aligned, aesthetically and functionally acceptable; then we can reproduce same alignment in the denture.

- **First way:**

Produce a labial index of the natural teeth before they are cut off the cast.

The index can be produced quite simply by moulding silicone putty against the labial surface of the teeth and ridge on the cast, wait till the material set, trim the cast, then the artificial teeth can be set into the index while its held against the cast preserving same teeth location.

In this technique same teeth morphology and location is duplicated, thus consultation with the patient about own teeth alignment and morphology must be made at the time or diagnosis.

- **Second way:**

Remove one tooth from the cast and immediately wax an artificial tooth into position so that the adjacent teeth serve as a guide to the positioning of the artificial replacement. Repeat this procedure alternatively, this is called the alternative or every other method; you can use every tooth as an index to arrange same tooth but in the other side or trim all the teeth on one side and use the other side as a reference.

Processing and finishing

- It is same as in the conventional complete denture.
- Do not remove posterior undercut and try to modify the path of insertion.
- Keep both the denture and the splint template in the disinfectant to delivery.

Insertion:

At the day of surgery and insertion:

- Examine the patient intraorally to check for any changes.
- Extraction of the marked teeth; preserve the labial plate and be conservative, no bone trimming is done without guiding; use suture if necessary.
- Use the surgical template to guide any alveolar corrections. Seat the template: blanch areas seen through the template indicates pressure, then need correction.
- Insert the denture; remove all the detected over extended especially healrs areas and correct any pressure areas. Check the frenum relief.

- ❖ Check for firm bilateral occlusion with no gross occlusal interference quickly correct.
- ❖ In some cases, the denture is not retentive and loose this is mostly occurs in the improper diagnosis and preparations or unexpected surgical problems.
- ❖ Usually, we use the tissue conditioner to retain the denture BUT do not allow the material to extend in the socket areas otherwise normal socket healing will be compromised.
- ❖ At the day of insertion try to reduce the numbers on insertion and removing of the denture to avoid trauma and oedema.

Post-operative care and instructions:

First 24 hours:

- ❖ Avoid removing the immediate denture.
- ❖ Put gentle biting pressure on your denture during the first four hours.
- ❖ Avoid hard food and eat soft healthy food, avoid drinking hot fluids.
- ❖ Using ice pack in the first 24h (20 min on followed by 20 min off) may control inflammation and swelling.
- ❖ Patient should be reminded that the pain from extraction will not reduce by removal the denture.
- ❖ Analgesic, antibiotic, must be prescribed to patient depending on the case.
- ❖ There may be some oozing of blood. The denture acts as a bandage to protect the extraction sites and helps to control bleeding and swelling.

1st Adjustment must be seen after 24 hours:

- ❖ The denture should be kept out of patient mouth only for short time, therefore quickly checking the tissue sore spots, over extension and any gross occlusal discrepancy.

- On removal the denture may be painful; inform the patient and adjust sore area which appears as deep red areas mostly undercuts as canine eminence, tuberosity, and retro mylohyoid ridge.
- Adjust occlusion.
- Assess retention and use tissue conditioner if needed.

1st week after extraction and denture insertion:

1. Instruct your patient to wear the denture day and night for first 7 days after extraction or until swelling reduction.
2. Remove the denture 4 or 5 times a day after the first day, and rinse the mouth with warm salt water. Do this for the first week.
3. The denture must be cleaned and rinsed after meal as early as possible and when removal and insertion of the denture is with little or tolerable pain.

Further follow up care:

1. 2nd week is the next call, this is depended on the case. Then the patient should be seen one month later, 4-6 months intervals.
2. A denture adhesive will be necessary to help hold the denture in place.
3. Relining may be necessary to achieve aesthetic and occlusion corrections.
4. Frequent or periodic recall mainly for changing temporary liner, this is depended on the rate and amount of bone resorption and ability of patient to keep the liner clean

Classification System for Complete Edentulism (continue)

Lec.12 **Dr. Safwan A. Suliaman**

Integration of Diagnostic Findings:

The previous four sub classifications are important determinants in the overall diagnostic classification of complete edentulism. In addition, variables that can be expected to contribute to increased treatment difficulty are distributed across all classifications according to their significance.

Diagnostic Classification of Complete Edentulism

Class I (Fig 14 A-H)

This classification level characterizes the stage of edentulism that is most appear to be successfully treated with complete dentures using conventional prosthodontics techniques. All four of the diagnostic criteria are favourable.

- Residual bone height of **21 mm** or **greater** measured at the least vertical height of the mandible on a panoramic radiograph.
- **Residual ridge morphology** resists horizontal and vertical movement of the denture base; Type A maxilla.
- Location of muscle attachments that are conducive to denture base stability and retention; Type A or B mandible.
- Class I maxillomandibular relationship

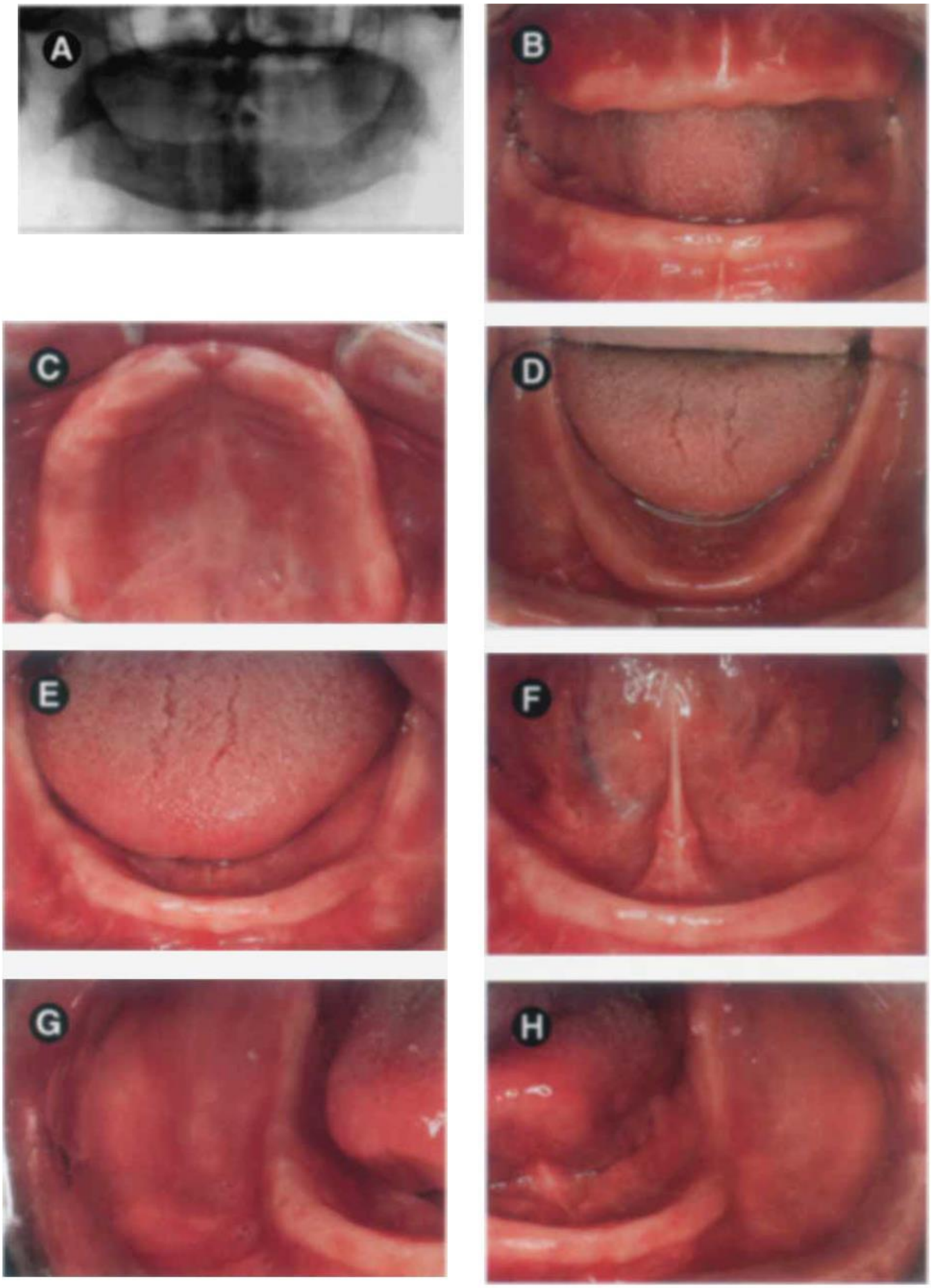


Figure 14. Class I patient. (*A*) Panoramic radiograph. (*B*) Facial view at the approximate occlusal vertical dimension. (*C*) Occlusal view: maxillary arch. (*D*) Occlusal view: mandibular arch. (*E*) Facial view: tongue in resting position. (*F*) Facial view: tongue elevated. (*G*) Lateral view of mandible: patient right. (*H*) Lateral view of mandible: patient left.

Class II (Fig 15 A-H)

This classification level distinguishes itself by the continued physical degradation of the denture supporting anatomy, and, in addition, is characterized by the early onset of systemic disease interactions, patient management, and/or life style considerations.

- Residual bone height of **16 - 20 mm** measured at the least vertical height of the mandible on a panoramic radiograph.
- Residual ridge morphology that resists horizontal and vertical movement of the denture base; Type A or B maxilla.
- Location of muscle attachments with limited influence on denture base stability and retention; Type A or B mandible. Lec.12
- Class I maxillomandibular relationship.
- Minor modifiers, psychosocial considerations, mild systemic disease with oral manifestation.

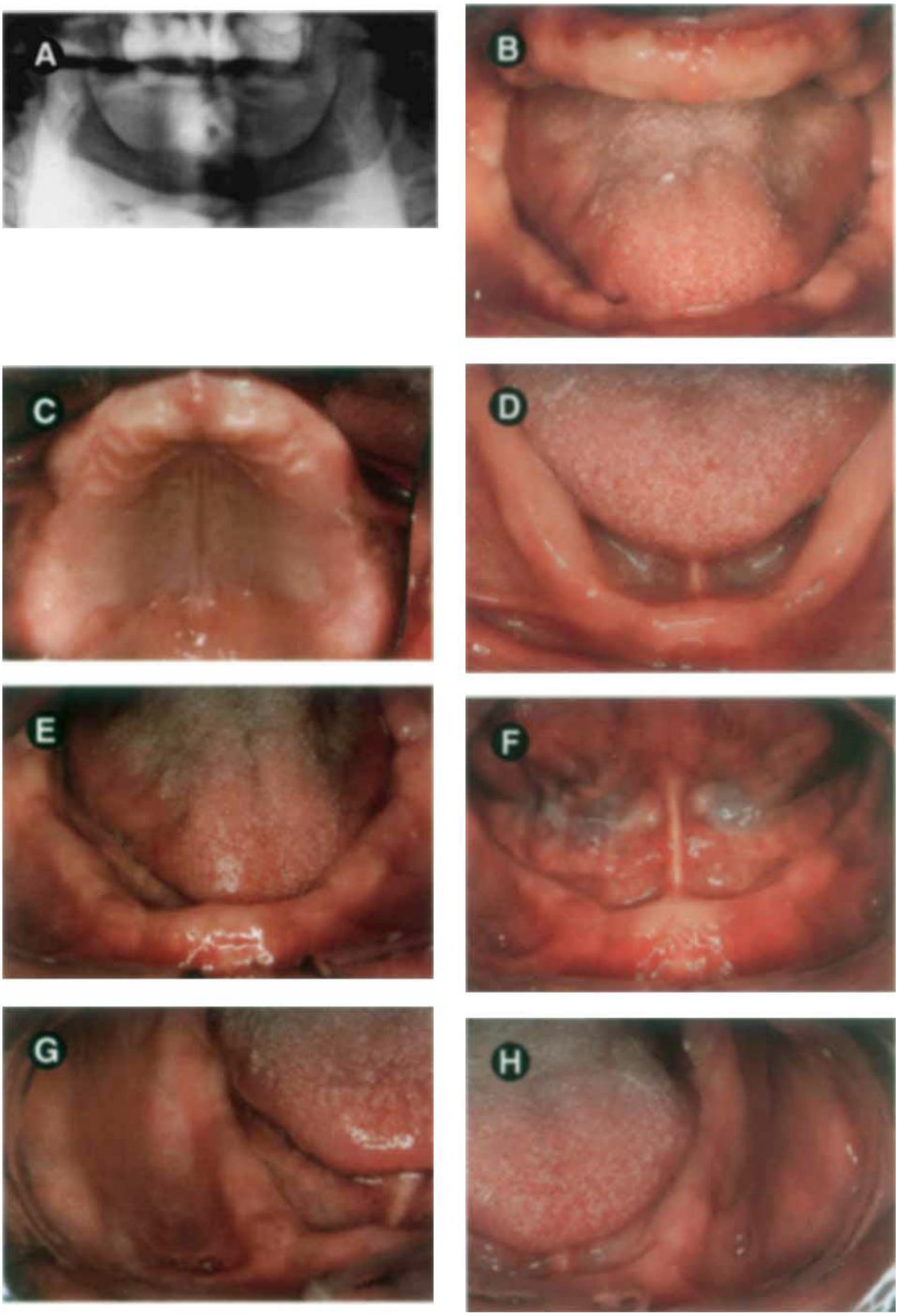


Figure 15. Class II patient. (*A*) Panoramic radiograph. (*B*) Facial view at the approximate occlusal vertical dimension. (*C*) Occlusal view: maxillary arch. (*D*) Occlusal view: mandibular arch. (*E*) Facial view: tongue in resting position. (*F*) Facial view: tongue elevated. (*G*) Lateral view of mandible: patient right. (*H*) Lateral view of mandible: patient left.

Class III

This classification level is characterized by the need for surgical revision of supporting structures to allow for adequate prosthodontic function. Additional factors now play a significant role in treatment outcomes.

- Residual alveolar bone height of 11 to 15 mm measured at the least vertical height of the mandible on a panoramic radiograph.
- Residual ridge morphology has minimum influence to resist horizontal or vertical movement of the denture base; Type C maxilla.
- Location of muscle attachments with moderate influence on denture base stability and retention; Type C mandible.
- Class I, II, or III maxillomandibular relationship.
- Conditions requiring preprosthetic surgery:

1) minor soft tissue procedures;
2) minor hard tissue procedures including alveolotomy.
3) simple implant placement, no augmentation
4) multiple extractions leading to complete edentulism for immediate denture placement.

- Limited interarch space (18-20 mm).
- Moderate psychosocial consideration and or moderate oral manifestations of systemic diseases or conditions such as xerostomia
- TMD symptoms present.
- Large tongue (occludes interdental space) with or without hyperactivity.
- Hyperactive gag reflex.

Class IV

This classification level depicts the most debilitated edentulous condition. Surgical reconstruction is almost always indicated but cannot always be accomplished because of the patient's health, preferences, dental history, and financial considerations. When surgical revision is not an option, prosthodontics techniques of a specialized nature must be used to achieve an adequate treatment outcome.

- Residual vertical bone height of 10 mm or less measured at the least vertical height of the mandible on a panoramic radiograph.
- Residual ridge offers no resistance to horizontal or vertical movement; Type D maxilla.
- Muscle attachment location that can be expected to have significant influence on denture base stability and retention; Type D or E mandible.
- Class I, II, or III maxillomandibular relationships.
- Major conditions requiring preprosthetic surgery:

1) complex implant placement, augmentation
2) surgical correction of dentofacial deformities;
3) hard tissue augmentation required;
4) major soft tissue revision required, ie, vestibular extensions with or without soft tissue grafting.

- History of paresthesia or dysesthesia.
- Insufficient interarch space with surgical correction required.
- Acquired or congenital maxillofacial defects.
- Severe oral manifestation of systemic disease or conditions such as sequelae from oncological treatment.
- Maxillo-mandibular ataxia (incoordination).
- Hyperactivity of tongue that can be associated with a retracted tongue position and/or its associated morphology.
- Hyperactive gag reflex managed with medication.
- Refractory patient (a patient who presents with chronic complaints following appropriate therapy).

These patients may continue to have difficult achieving their treatment expectations despite the thoroughness or frequency of the treatments provided.

- Psychosocial conditions warranting professional intervention

Reasons for a Classification System

Classifying edentulous patients according to present criteria can be an aid in numerous aspects of treatment:

• establishing a basis for diagnostic and treatment procedures

• justifying treatment procedures and fees to patients

• screening patients treated in dental faculties for assignment to undergraduate or graduate students

• providing data for review of treatment outcome

• simplifying communication in discussions of treatment with patients and colleagues.

The classes are differentiated from each other according to the following features:

• The skill level required to treat that class of patient:

Does the patient require novice or expert treatment?

• The necessity for modification of basic clinical or laboratory procedures:

Will more complicated procedures or more time be required for treatment?

• Overall management and complexity of treatment:

Will expert intervention and referral be required?

Guidelines for Use of the Complete Edentulism Classification System

In those instances when a patient's diagnostic criteria are mixed between two or more classes, any single criterion of a more complex class places the patient into the more complex class. The analysis of diagnostic factors is facilitated with the use of a worksheet.

Use of this system is indicated for pre-treatment evaluation and classification of patients. Re-evaluation of classification status should be considered following preprosthetic surgery. Retrospective analysis on a post treatment basis may alter a patient's classification.

The classification system for complete edentulism is based on the most objective criteria available to facilitate uniform utilization of the system. With such standardization, communication will be improved among dental professionals.

This classification system will help to identify those patients most likely to require treatment by a specialist or by a practitioner with additional training and experience in advanced techniques.

This system should also be valuable to research protocols different treatment procedures are evaluated.

Table 1. Checklist for Classification of Complete Edentulism

			Class I	Class II	Class III	Class IV
Bone Height-Mandibular						
	21 mm or greater					
	16-20 mm					
	11-15 mm					
	10 mm or less					
Residual Ridge Morphology-Maxilla						
	Type A -	resists vertical & horizonal, hamular notch, no tori				
	Type B -	no buccal vest., poor hamular notch, no tori				
	Type C -	no ant vest, min support, mobile ant. ridge				
	Type D -	no ant/post vest, tori, redundant tissue				
Muscle Attachments-Mandibular						
	Type A -	adequate attached mucosa				
	Type B -	no b attach mucosa (22-27), +mentalis m				
	Type C -	no ant b&l vest (22-27), +genio & mentalis m				
	Type D -	att mucosa only in post				
	Type E -	no att mucosa,cheek/lip moves tongue				
Maxillomandibular Relationships						
	Class I					
	Class II					
	Class III					
Conditions requiring Preprosthetic Surgery						
	Minor soft tissue procedures					
	Minor hard tissue procedures					
	Implants - simple					
	Implants with bone graft - complex					
	Correction of dentofacial deformities					
	Hard tissue augmentation					
	Major soft tissue revisions					
Limited Interarch Space						
	18-20 mm					
	Surgical correction needed					
Tongue Anatomy						
	Large (occludes interdental space)					
	Hyperactive - with retracted position					
Modifiers						
	Oral manifestations of systemic disease					
		mild				
		moderate				
		severe				
	Psychosocial					
		moderate				
		major				
	TMD symptoms					
	Hx of paresthesia or dysesthesia					
	Maxillofacial defects					
	Ataxia					
	Refractory Patient					

Classification system for completely edentulous patients

Lec.11 **د.صفوان عبدالحميد**

The American College of Prosthodontists (ACP), has developed a classification system for complete edentulism based on diagnostic findings. These guidelines may help practitioners determine appropriate treatments for their patients.

Four categories are defined, ranging from **Class I** to **Class IV**, with Class I representing an uncomplicated clinical situation and a Class IV patient representing the most complex and higher-risk situation. Each class is differentiated by specific diagnostic criteria. This system is designed for use by dental professionals who are involved in the diagnosis of patients requiring treatment for complete edentulism.

Potential benefits of the system include:

1. Better patient care.
2. Improved professional communication.
3. More appropriate insurance reimbursement.
4. A better screening tool to assist dental school admission clinics.
5. Standardized criteria for outcomes assessment.

Completely edentulous patients exhibit a broad range of physical variations and health concerns. Classifying all edentulous patients as a single diagnostic group is insensitive to the multiple levels of physical variation and the differing treatment procedures required to restore function and comfort. A graduated classification of complete edentulism has been developed that describes varying levels of loss of denture supporting structures.

Complete edentulism defines as follows: "*the physical state of the jaw(s) following removal of all erupted teeth and the condition of the supporting structures available for reconstructive or replacement therapies*".

Development of the classification system:

A review of the prosthodontic literature was used to identify the many variables associated with complete edentulism. These variables were differentiated into four subclasses:

1. Physical findings.
2. Prosthetic history.
3. Pharmaceutical history.
4. Systemic disease evaluation.

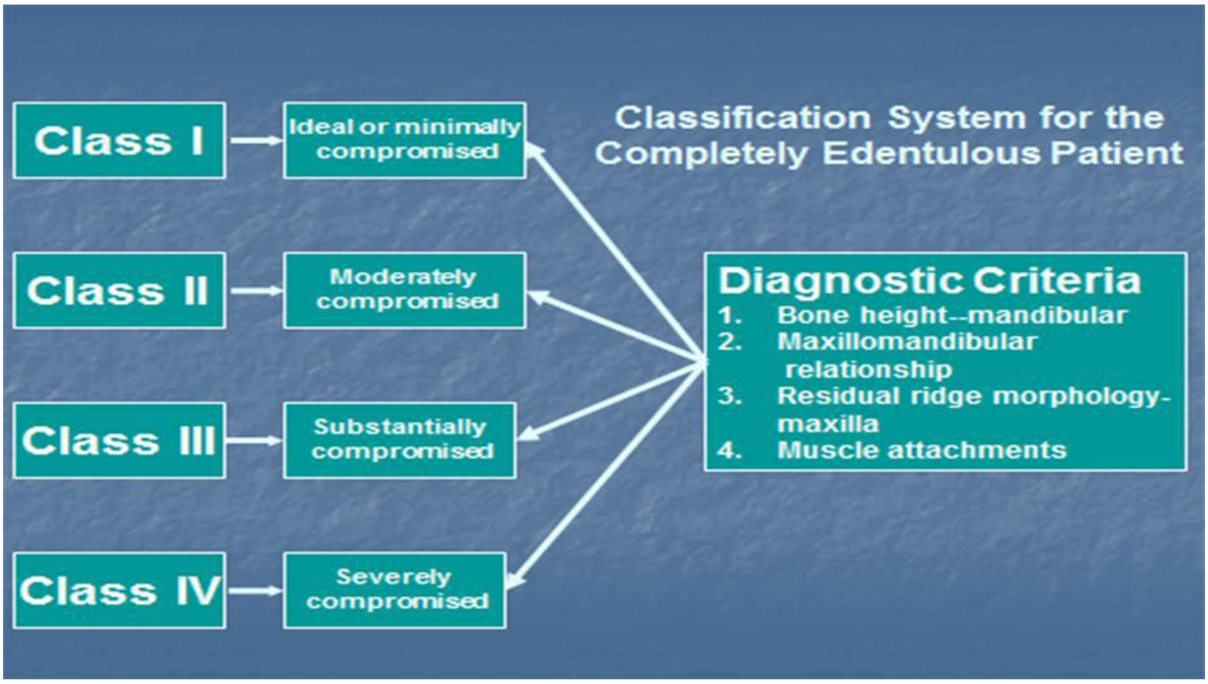
A classification system was developed based on the most objective variables. The classification system will be subject to monitoring and revision as new diagnostic and treatment information becomes available in the literature.

Diagnostic Criteria

The diagnostic criteria are organized by their objective nature and not in their rank of significance. Because of variations in adaptive responses, certain criteria are more significant than others. However, objective criteria will allow for the most accurate application of the classification system and measurement of its efficacy.

The diagnostic criteria used in the classification system are:

1. Bone height-mandible.
2. Maxillomandibular relationship.
3. Residual ridge morphology-maxilla.
4. Muscle attachments-mandible.



Bone height-mandible only:

The identification and measurement of residual bone height is the most easily quantified objective criterion for the mandibular edentulous ridge. In addition, it represents a measurement of the chronic debilitation associated with complete edentulism in the mandible. Despite the lack of a known aetiology, it has been established that the loss of denture supporting structures does occur. ***Atwood's*** description in 1971 of alveolar bone loss is still applicable today: "Chronic progressive, irreversible and disabling process probably of multifactorial origin. At the present time, the importance of various cofactors is unknown". The continued decrease in bone volume affects:

1. Denture-bearing area.
2. Tissues remaining for reconstruction.
3. Facial muscle support/attachment.
4. Total facial height.
5. Ridge morphology.

The results of a radiographic survey of residual bone height measurement are affected by the variation in the radiographic techniques and magnification of panoramic machines of different manufacturers.

To minimize variability in radiographic techniques, the measurement should be made on the radiograph at that portion of the mandible of the **least vertical height**. The values assigned to each of the four types listed below are averages that historically have been used in relation to preprosthetic surgical procedures. A measurement is made and the patient is classified as follows:

Type I (most favourable): residual bone height of **21mm** or **greater** measured at the least vertical height of the mandible.

Type II: residual bone height of **16 - 20 mm** measured at the least vertical height of the mandible.

Type III: residual alveolar bone height of **11-15mm** measured at the least vertical height of the mandible.

Type IV: residual vertical bone height of **10 mm** or **less** measured at the least vertical height of the mandible.

Residual ridge morphology-maxilla only:

Residual ridge morphology is the most objective criterion for the maxilla, because measurement of the maxillary residual bone height by radiography is not reliable. The classification system continues on a logical progression, describing the effects of residual ridge morphology and the influence of musculature on a maxillary denture.

Type A (most favourable):

1. Anterior labial and posterior buccal vestibular depth that resists vertical and horizontal movement of the denture base.

2. Palatal morphology resists vertical and horizontal movement of the denture base.
3. Sufficient tuberosity definition to resist vertical and horizontal movement of the denture base.
4. Hamular notch is well defined to establish the posterior extension of the denture base.
5. Absence of tori or exostoses.

Type B:

1. Loss of **posterior** buccal vestibule.
2. Palatal vault morphology resists vertical and horizontal movement of the denture base.
3. **Tuberosity** and **hamular** notch are **poorly defined**, compromising delineation of the posterior extension of the denture base.
4. Maxillary palatal tori and/or lateral exostoses are rounded and do not affect the posterior extension of the denture base.

Type C:

1. Loss of **anterior** labial vestibule.
2. Palatal vault morphology **offers minimal resistance** to vertical and horizontal movement of the denture base.
3. Maxillary palatal tori and/or lateral exostoses with bony undercuts that do not affect the posterior extension of the denture base.
4. Hyperplastic, mobile anterior ridge offers minimum support and stability of the denture base.
5. **Reduction of the post malar space** by the coronoid process during mandibular opening and/or excursive movements.

Type D:

1. Loss of **anterior labial and posterior buccal vestibules**.

2. Palatal vault morphology does **not resist vertical** or **horizontal** movement of the denture base.
3. Maxillary palatal tori and/or lateral exostoses"(rounded or undercut) that **interfere with the posterior border of the denture**.
4. Hyperplastic, redundant anterior ridge.
5. Prominent anterior nasal spine.

Muscle Attachments: Mandible only

The effects of muscle attachment and location are most important to the function of a mandibular denture. These characteristics are difficult to quantify. The classification system follows a logical progression to describe the effects of muscular influence on a mandibular denture. The clinician examines the patient and selects the category that is most descriptive of the mandibular muscle attachments.

Type A (most favourable):

Attached mucosal base without undue muscular impingement during normal function in all regions.

Type B:

1. Attached mucosal base in all regions except labial from canine to canine.
2. Mentalis muscle attachment near crest of alveolar vestibule ridge.

Type C:

1. Attached mucosal base in all regions except anterior buccal and lingual vestibules-canine to canine.
2. Genioglossus and mentalis muscle attachments near crest of alveolar ridge.

Type D:

1. Attached mucosal base only in the posterior lingual region.

2. Mucosal base in all other regions is detached.

Type E:

No attached mucosa in any region.

Maxillomandibular Relationship

The classification of the maxillomandibular relationship characterizes the position of the artificial teeth in relation to the residual ridge and/or to opposing dentition. Examine the patient and assign a class as follows:

Class I (most favourable):

Maxillomandibular relation allows tooth position that has normal articulation with the teeth supported by the residual ridge.

Class II:

Maxillomandibular relation requires tooth position outside the normal ridge relation to attain aesthetics, phonetics, and articulation (e.g., anterior or posterior tooth position is not supported by the residual ridge; anterior vertical and/or horizontal overlap exceeds the principles of fully balanced articulation).

Class III:

Maxillomandibular relation requires tooth position outside the normal ridge relation to attain aesthetics, phonetics, and articulation (i.e., cross bite-anterior or posterior tooth position is not supported by the residual ridge).

Integration of Diagnostic Findings

The previous four sub classifications are important determinants in the overall diagnostic classification of complete edentulism. In addition, variables that can be expected to contribute to increased treatment difficulty are distributed across all classifications according to their significance.

Arrangement of artificial teeth in abnormal jaw relations:

Maxillary protrusion and wider upper arch (class II jaw relation).

Arrangement of anterior teeth in maxillary protrusion.

As the upper arch in these situations is further forward in the anterior region, the first problem is that of an excessive amount of overjet (horizontal overlap) which results in an abnormal upper and lower canine tooth relationship. No attempt should be made to reduce this horizontal overlap by moving the upper anterior teeth palatally or the lower anterior teeth labially.

Management:

The management of such situation can be attempted in any of the following ways, depending upon the severity of the maxillary protrusion.

1. If the protrusion is **not** *too extreme*, the simplest way is to **select the lower anterior teeth of a narrower mesiodistal width** and try to achieve the normal canine relationship.
2. If aesthetics permit, a **little crowding of the lower anterior teeth** by overlapping may solve the problem well.
3. Another solution which is effective at times is **leave slight spaces between the upper anterior teeth to attain normal canine relations**. However, such a procedure is aesthetically limited.
4. In situations where the **discrepancy is not too great**, **grinding of the distal surface of lower canine is sufficient to restore the normal canine relationship.**
5. In situations where the **discrepancy is excessive** and cannot be managed by the manipulation and modification of the lower anterior teeth, the lower anterior teeth must be left as they are, and the **lower first premolars must be eliminated from the dental arch.**

Arrangement of posterior teeth when the upper jaw is wider as in Cl II jaw relation:

In this situation, the lower crest of the ridge in the posterior region is lingual to the upper residual ridge. This relationship is not very common, but when present, it may give rise to considerable difficulty in the placement of upper and lower teeth in their correct occlusal relationship. In such instances, the upper arch is wider than the lower, and if the upper teeth are placed on the crest of the ridge, they will make inadequate occlusal contact with the correctly placed lower teeth. At the same time, if an attempt is made to occlude the lower teeth with the correctly placed upper teeth, the lower teeth will place too far buccally leading to an instability of the lower denture. This is much more detrimental as the lower denture-bearing area is already very small.

Management:

The following methods of correction may be employed:

1. If the **discrepancy is very slight**, the **upper teeth are moved slightly in a palatal direction** to provide a working occlusal contact with the lower teeth. However, such a procedure has a very limited application as the upper posterior teeth cannot be moved inside (palatally) to any great extent without affecting phonetics and cheek support.
2. If the **upper arch is much wider than the lower** one, any of the following methods can be used successfully:

a. The lower posterior teeth are correctly placed on the crest of the ridge. The upper teeth are then set so that they occlude well with the lower teeth. Then the buccal contours are built on the upper teeth in wax which is later replaced by tooth-coloured acrylic resin to fulfil aesthetic requirements and to provide support for the cheek.

b. Another method can be used alternatively for the same problem. The upper posterior teeth are arranged first to meet the requirements of aesthetics. The lower teeth are kept on the crest of the ridge. This will result in an unfavourable occlusal relationship of the upper and lower posterior teeth. In order to establish a functional occlusal contact between the upper and lower posterior teeth, wax is added on the palatal aspect of the upper posterior teeth. This wax is later replaced by tooth coloured acrylic resin. This gives a functionally effective occlusal contact as well as an aesthetically acceptable buccal surface contour of the upper posterior teeth. Non-anatomical posterior teeth are best for these procedures as they allow more freedom in their buccolingual placement.

Arrangement of artificial teeth in abnormal jaw relations: Mandibular protrusion and wider lower arch (class III jaw relation):

Arrangement of anterior teeth in mandibular protrusion.

This condition is characterized by the lower anterior ridge being forward in relation to the maxillary ridge. This may vary from edge-to-edge relation (where both upper and lower ridges are at the same level) to a marked prognathism (in which the lower ridge is forward in relation to the upper ridge).

Management:

These situations can be managed by any of the following methods, depending upon the severity of the mandibular protrusion.

1. **If the ridges are in an edge-to-edge relation**, the incisal edges of the upper and lower incisors and cuspids will also **meet in edge-to-edge relationship.** The upper and lower teeth are placed as near as possible to the labial plates of bone in their respective ridges. No attempt should be made to introduce normal horizontal overlap if the ridge relation does not permit it.

2. **With an extreme protrusion of the mandible**, a negative or reverse horizontal labial overlap must be used. The **lower anterior teeth are placed labial to the upper anterior teeth**. The magnitude of the reverse horizontal overlap depends upon the amount of protrusion of the lower residual ridge.
3. **If the difference in ridge size is too great**, one of the following methods may be used to solve the problem.

a. Use a **slightly larger lower-tooth mould** than that suggested for normal use with the upper teeth. This will compensate for the greater lower-arch width. This is the simplest method.

b. Use a **slight overlapping in the upper anterior teeth**, if aesthetically acceptable. This will automatically narrow the lower-arch space and may eliminate spacing.

c. **Use an extra lower incisor to avoid the spaces**. However, this is hardly an acceptable measure. It is better, aesthetically, to leave some spaces between the lower anterior teeth than for the dentures to appear to have too many teeth.

The relationship of the upper and lower canines in this situation does not present much of a problem. The lower anterior teeth are set in a forward relation to the upper anterior teeth. The distal surface of the lower canine coincides with the tip of the upper canine. If it finishes mesial to the canine tip, the discrepancy can be rectified by using small spaces between the lower anterior teeth so that the canine teeth will have their normal relationship.

Arrangement of posterior teeth when the lower arch is wider:

Management:

An arrangement for the posterior cross-bite relationship will depend on the severity of its deviation from normal. One of three procedures may be used.

1. If the difference in size is slight and the upper ridge is well formed, the **upper posterior teeth** can be **set slightly buccal to the crest of the upper ridge** in such a position that correctly placed lower posterior teeth can make effective occlusal contacts with their antagonists. This should not be done to an extent that it introduces potential midline fracture in the upper denture.
2. **Non-anatomical teeth may be used**. These teeth allow more freedom in their buccolingual placement and still provide an adequate occlusal contact between the upper and lower teeth. The teeth can still be kept on the crests of the respective ridges without losing the desired occlusal contacts.
3. If the **lower arch is too wide and cannot be managed** otherwise, an **interchange** can be accomplished by **using upper teeth on the lower denture and lower teeth on the upper denture**. The interchange is made across the arch as well. The *right upper teeth are placed on the left lower ridge*, and *left lower teeth are placed on the right upper ridge*. Similarly, the left upper posterior teeth are set on the right lower ridge, and right lower posterior teeth are placed on the left upper ridge. Start by placing the lower teeth on the upper ridge. As the *upper arch is already smaller* in these patients, it is imperative that the first premolar tooth be eliminated from the arch to develop correct intercuspal relationships. The second premolar, first molar, and second molar (lower teeth) are set on the upper ridge. The buccal cusps of these teeth correspond to the guideline of the lower occlusal rim. Sometimes a **cross-bite setting** (i.e., a reverse horizontal buccal overlap) is suggested without interchanging the teeth between the two arches. The success of such an arrangement of teeth is doubtful, as anatomically they are not meant to intercuspate with each other in this relationship. However, it might be attempted if non-anatomical posterior teeth are used.

Geriatric dentistry related to prosthetic

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Geriatric Dentistry: Geriatric dentistry is the branch of dentistry that emphasizes dental care for the elderly population and focuses upon patients with chronic physiological, physical and/or psychological changes or morbid conditions/diseases. Oral health reflects overall wellbeing for the elderly population.

Dental geriatrics:

1. The branch of dental care involving problems peculiar to advanced age and aging;

2. Dentistry for the aged patient

Growth is increase in size.

Development is progress towards maturity.

Maturation is the stabilization of the adult stage brought about by the growth and development.

Aging Refers to irreversible and inevitable changes occurs with time. It is also defined as the sum of all morphologic & functional alterations that occur in an organism and lead to functional impairment which decline the ability to survive stress.

Gerontology: Is the study of aging in all its aspects biologic, physiologic, sociologic & psychologic.

Gerodontics: the treatment of dental problems of aging persons; also spelled geriodontics.

gerodontology: the study of the dentition and dental problems in aged or aging persons.

What causing Aging?

Medvedev listed 300 theories that have been offered in an attempt to answer this but nothing conclusive comes. The consensus today is that aging is the end result of multiple biological processes which includes:

Genetic level:

Where information for the initiation & maintenance of cellular functions are encoded.

Cellular level:

Where integrity of somatic cells is maintained.

Organ& Organ system level: Where physiologic functions are performed

Coordination level: Physiologic functions are controlled & assembled into complex function

Factors influencing Aging:

A) Genetic:

1- Mutation: Several mutations reduce life span

2. Species specific life span: Each species is characterized by its own pattern of aging & maximum life span.

3. Hybrid vigor: The effect of genetic constitution on longevity is perhaps best exemplified where hybrid vigor is demonstrated.

4. Sex: In humans\animals, female lives longer.

5. Parental age: Like father like son.

6. Premature aging syndrome: Single gene changes results in premature senescence in humans e.g., progeria, Cockayne's syndrome, Werner's syndrome (rapid premature aging)

B) Environmental:

1. Physical and chemical: Pollution, radiations, working atmosphere etc.

2. Biological factors: Nutrition, general health etc.

3. Pathogens and Parasites: They influence the rate of human development → low-income group/tropical countries.

4. Socioeconomic conditions: Bad housing, stresses etc.

Aging Vs others

• It has always been difficult for researchers to differentiate whether the changes in tissues/organ system are due to physiologic aging or pathologic.

• There is no precise method for determining the rate or degree of aging because Aging → Systemic diseases → Surgeries, medications, chemotherapy, radiotherapy → Alterations in body → Changes…superimposes.

Goal of Geriatric dentistry

1. To maintain oral health of individuals.
2. To maintain ideal health and function of masticatory system by establishing adequate preventive measures.
3. In diseased patients maintaining oral and general health.

Objectives of Geriatric dentistry

1. To recognize and relieve difficulties of elderly people.
2. Restoration and preservation of function for maintaining normal life in elderly patients.

Psychological disorders of elderly patients generally seen by prosthodontist

Anxiety: It is a response to the perception of danger, actual or anticipated. Its purpose is to alert individuals to danger, so as to prepare them to cope with it. A major source of anxiety is alteration of body integrity and the way the body functions. Extensive changes in oral cavity (loss of teeth and replacement with denture) represent such a threat and therefore can trigger anxiety.

Depression: It is a response to loss, actual or threatened, real or fantasized. Sadness and hopelessness are the common feelings when significant loss is experienced, such as loss of loved one or loss of a body part. The impact is particularly serious when it is involved emotionally on the invested parts of the body such as face (teeth). For some patients, the teeth have become so invested with meaning that their loss is experienced as catastrophic.

Conversion Hysteria: This means, people convert the anxiety from emotional conflicts into somatic symptoms such as pain, muscle weakness, or sensory disturbance, or they reproduce a symptom which they had at some time in the past.

Body image disturbance: The mouth is the most emotionally charged area of the body and therefore, frequently involved in body image disturbance. Any alteration to the patient’s mouth is a body change to which they must adapt; until they do anxiety will be present.

Factors that influence the patient’s response

1. **Parental influences:** The parental attitude toward body values is assumed by the children and this is obviously true regarding the value and appearance of the mouth. Patients who, as children, observe their parents undergoing dental treatment may become traumatically, conditioned by such observations.

2. **Sibling's influence:** The behavior of siblings also has a strong influence on the dental attitude developed by patients.
3. **Peer group:** A person is influenced to some extent by his peer group.
4. **Symbolic significance:** The more common symbolic significance of tooth loss is aging, loss of femininity, loss of virility, loss of attractiveness and vitality and body degeneration.
5. **Current life circumstances:** Where one's life is already seriously disrupted, additional traumas such as tooth loss may impair the ability to cope and increase the probability of a maladaptive response.

Seven basic personality traits will be considered in the light of their influence on success in dentistry. Maximum benefits will be obtained only by those who make an honest attempt to search for personal shortcomings, because of general failing to underestimate grossly personal weakness.

BE AGREEABLE A group of postgraduate students was asked by Cranes to select the dentist they considered best of those they had visited and write down the reasons for their choice. First on the list, when their answers had been tabulated was. “He was cheerful, friendly, and congenial.” Courtesy, politeness, and accommodation cost not one cent, yet they may be sold. Some of the most successful dentists keep a card index system under which is listed personal information about each patient and his family. By the dentist’s being conversant with affairs that are of personal interest, each patient is made to feel that he occupies a position of special importance in the practice. The dentist who can make patients “feel at home” in his office will never be worried about future dental practice.

BE A GOOD LISTENER “A bore is the fellow who keeps talking about himself when I want to talk about myself.” Cultivate the habit of listening, not merely remaining silent while another speaks, but giving others their undivided attention.

Too many people are so concerned about what they are going to say as soon as an opening presents itself that they do not really listen. listening is an art. Some individuals, without uttering a word, can be more flattering than most people. If patients are encouraged to “think out loud” it gives the dentist an opportunity to size up each individual, to learn something of his likes, dislikes, prejudices, and to plan a presentation accordingly. If the dentist wants to enjoy maximum success he must, of course, be a good conversationalist and an enthusiastic educator, but, first of all, he should be a good listener.

AVOID ARGUMENTS It must be remembered that force never won a permanent victory on the battlefield, and verbal force, which is just another way of describing arguing; there are times when one must fight for principles. One can convince few men and certainly no woman by arguing. Crane’ says, “Guide me deftly to the decision you want me to make--don’t crowd, don’t shove, just feed me ideas as fast as I can absorb them. If you can influence me to persuade myself, I will sign.”

CRITICIZE TACTFULLY In general, it can be said that criticism is futile because it aims a death blow at one’s self-respect by undermining the feeling of personal worth. Criticism places people on the defense; it makes them appear foolish and silly. It usually opens up deep wounds that never heal, but fester down through the years. Yet it is possible to criticize and accomplish the proper results without offending. It merely requires a little tact. Hence an excellent policy to follow: compliment first, and then tactfully offer constructive criticism.

DON’T BE EGOTISTIC Individuals simply cannot wait for others to discover their good qualities; they extol their own virtues at every opportunity and, in so doing, arouse a feeling of antagonism among those with whom they come in contact. It is important to wait for the others appreciate the effective dental service that you provide.

REMEMBER NAME AND FACES We can give people nourishment for their self-esteem by making it a point to remember their name. Anyone, who wishes, can improve his memory simply by listening attentively and concentrating on the name at the time of the introduction. Safer method is to place names of patients and their children on a card. together with any other information deemed worthwhile.

BE INTERESTED IN OTHERS Dentists in general become more interested in things than in people. The habit of being interested in others find that, without making any conscious, effort, without realizing exactly why, they hold in their hands the key, the open sesame to the hearts and minds of people.

Systemic Diseases and its dental relation

Cardiovascular diseases (CVD) and periodontitis has interrelationship because of common bacteria associated with its pathogenesis. Periodontal inflammation leads to bacteremia caused by common oral pathogens like Porphyromonas Gingivalis. This microorganism has been isolated from CVD like coronary and carotid atheromas. Therefore, CVD and Periodontitis are interrelated and commonly seen in geriatric patients.

Infective endocarditis, other common disease found in elderly patients has association with periodontitis. The bacteria like viridians streptococci normally found in oral cavity, whereas the bacteria found in dental plaque like Actinobacillus actinomycetemcomitans, Eiknella Corrodens, Fusobacterium Nucleatum and Bacteriodes Forsythus have been isolated from the blood sample of Infective endocarditis patients.

Respiratory infections are usually caused by oropharyngeal and periodontal microorganism and bacteria. The main cause of respiratory infections and bacterial pneumonia in adults is aspiration of oropharyngeal bacteria. This micro flora habitats in inadequate oral hygiene resulting in formation of dental plaque further serving as a reservoir for respiratory pathogens.

The other common disease **Rheumatoid arthritis** (RA) is seen in elderly patients. This RA has similar characteristic of periodontitis as there is destruction of hard and soft tissues as a result of inflammatory response. However, the interrelationship as well as association between RA and periodontitis has not been proved.

Diabetes Mellitus (DM) the other most common disease seen adult and elderly individuals in 21st century. It has been proved and found that the patients suffering from Type 1 and Type 2 DM have distinguished dental manifestations such as loss of periodontal attachment, gingival and periodontal abscess and early loss of teeth.

Effect of Aging on Oral Tissues (Gerontology of the Oral Cavity)

1. Losses of tooth support structures (periodontium).
2. increased loss of epithelium attachment and alveolar bone in the elderly.
3. temporomandibular joints,
4. orofacial/mastication muscles, oropharyngeal mucosa, and oral sensory/motor nerve systems.
5. salivary gland function, taste, tactile sensation and swallowing

Often there is no clear demarcation between normal physiological aging and pathological diseases. However, there may be some specific changes in individual tissues during aging, e.g.,

- Losses of tooth translucency and surface details
- Abrasion, attrition, and erosion of teeth usually increase with advancing age.
- The dental pulp becomes smaller.

Geriatric Dentistry differs from traditional general practice in the following aspects:

1. It is concerned with aging patients, 86% of whom have at least one chronic disorder. (Nursing home residents may have as many as 25 concurrent disorders).
2. Cognitive Dysfunction such as dementia affects compliance and oral health.
3. Use of Polypharmacy causes xerostomia. (Over 1000 medications cause dry mouth)
4. Many elderlies have physical disabilities such as vision, hearing and taste disorders.
5. Requires exceptional skill in history taking.
6. Challenges the dentist's ability to design treatment plan and differentiate normal aging from pathologic aging.

Pathological Oral Conditions in The Elderly

- Conditions affecting the periodontium & tooth structure.
- Ulcerative lesions.
- Denture related condition
- Xerostomia (dry mouth)
- Tongue Conditions
- White lesions
- Malignant lesions
- Vesiculo-bullous lesions

- Pigmented lesions

Salivary glands and saliva

There are **3 major paired** & **several minor salivary glands** present in oral cavity.

Major glands are:

parotid, sublingual, submandibular

Minor glands are:

labial, buccal, palatal

Primary function: exocrine production of saliva.

Major roles of saliva in maintenance of oral health

1. Preparation & translocation of food bolus.
2. Lubrication of oral mucosa.
3. Preservation of microbial balance.
4. Mechanical cleansing.
5. Antibacterial & antifungal activities.
6. Maintenance of oral pH.
7. Remineralization of dentition.
8. Mediation of taste activity.

Salivary function during aging

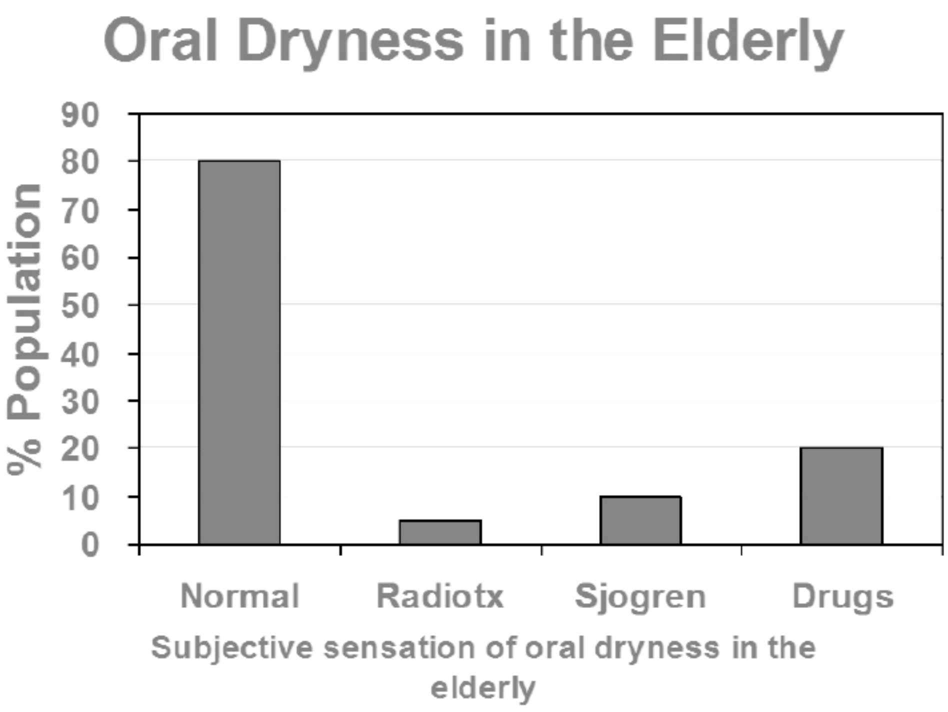
There occurs a fairly linear loss of acinar cells, replaced by fatty or connective tissue.

- Submandibular gland – 40% loss of acinar cells
- Parotid gland - 30% loss of acinar cells
- Minor labial glands - 45% loss of acinar cells.

Morphometric studies show

- Proportion of gland parenchyma occupied by acinar cells is reduced by 25% - 30%.
- Atrophy of acinar cells.
- Proliferation of ductal elements.
- Some degenerative changes.

Earlier, it was thought that salivary secretion is also reduced with age but recent functional studies showed, despite the appearance of age related morph metric changes in salivary glands - Functional output & composition of saliva doesn’t appear to be consistently altered in older but otherwise healthy persons. The decrease in salivary production is more related to salivary gland dysfunction & related oral morbidities associated with systemic diseases & medications.



Oral mucosal barrier

The oral mucosa performs essential protective function that profoundly affect the general health & wellbeing of host.

- It provides first line of defines.
- Specialized mucosal sensory detectors serve to warn us of many potentially harmful situations such as spoiled food stuffs, temperature extremes, sharp objects, etc.
- Any changes in O.M. barrier could expose the aging host to myriads of pathogens & chemicals that enter the oral cavity.
- Both histologic layers of oral mucosa, epithelium, & connective tissue have important defensive functions.
- Stratified squamous epithelium containing attached oppose cells forms physical barrier which restricts entry of microorganisms & toxic substances.
- Mucosal epithelial cells synthesize keratin & laminin. Laminin Preserve structural integrity & restore wound healing. Keratin (masticatory mucosa) Protect against abrasive insults e.g., stiff foods.

But literature doesn't give clear picture of histologic status of O.M. with normal aging. Reports says thinning of epithelium while others contradict.

Effects of aging on periodontium

a. Gingival epithelium

- Thinning & decreased keratinization of the gingival epithelium
- Flattening of rete pegs, altered density.
- Migration of functional epithelium from its position in healthy individual (on enamel) to more apical position on the root surface with accompanying gingival recession.

b. Periodontal ligament (pdl)

A fibrous connective tissue that is noticeably cellular & vascular. Its functions are:

- Attachment & Support
- Nutrition
- Proprioception
- Synthesis

Periodontal Disease Etiology:

- Gram positive and negative bacteria
- Exacerbated in the elderly by diminished motor dexterity (Arthritis, Stroke) and poor hygiene.
- Wide spectrum range of gingivitis, inflammation of sulcular epithelium, recession to periodontal pocketing

Treatment:

- Antimicrobial therapy (chlorhexidine 0.12% mouth wash, tetracycline impregnated sulcular fibers, metronidazole 500 mg qid "four times a day." or clindamycin 300 mg qid for 10 days).
- Surgical elimination of pockets.

c. Cementum

Cementum continuous be laid throughout life but rate of formation diminishes with age. A thickening of cementum is observed on teeth that are not in function (hypercementosis).

- increase in cemental width (5-10 times) as cementum deposition is continues after tooth eruption.
- increase in width is greater apically & lingually

d. Alveolar bone (in relation to periodontium)

A more irregular PDL surface of bone and less irregular insertion of collagen fibers. Healing of bone in extraction socket appears to be unaffected by aging.

e. Bacterial plaque

- Dentogingival plaque accumulation increase because increase in hard tissue surface area as a result of gingival recession and the surface characteristic of the exposed root surface for plaque formation compared to enamel.

Aging and teeth

Enamel changes Chemically

- Increase levels of N_2 & fluorine therefore, increase organic matrix.
- Enamel near the surface become darker & decay resistant
- There is reduced permeability & enamel becomes brittle.

Attrition:

It may be defined as physiological wear of occlusal or incisal surfaces and proximal contacts as a result of mastication, physiologic tooth movement, functional or parafunctional movements of mandible.


Clinical features

- **a.** Small polished facets on cusp tips\ridges\slight flattening of incisal edges
- **b.** Because of slight mobility of teeth in their sockets & a manifestation of resiliency of pdl, facets also occur at proximal surface.
- **c.** Decreased cusp height
- **d.** Flattening of occlusal plane.
- **e.** Shortening of length of dental arch

(All these changes occur more severely in men than women due to greater masticatory force)

Abfraction:

Recently, it has been proposed that the predominant causative factor of some of the cervical, wedge-shaped defects is a strong (heavy) eccentric occlusal force resulting in microfracture or abfracture, such microfracture occur as the cervical area of the tooth flexes under such loads.

• This defect is termed as Idiopathic erosion or abfraction.

Dentin changes

- **Vitality of dentin**

Since odontoblasts & its processes are integral part of dentin, therefore, there is no doubt that dentin is vital tissue.

It is laid throughout life though as age progress dentinogenesis slows.

Aging and functional changes in dentin

Reparative\secondary dentin

If attrition, abrasion, erosion, cavity cutting procedures causes odontoblast processes to cut or exposed, either they die or if they live, they form dentin called as **reparative dentin**.

Fig. 5-5. Diagram of tooth showing the narrowing of the pulp chamber by secondary dentin. Note that relatively more secondary dentin is deposited on the ceiling and floor of the pulp chamber than on the walls.

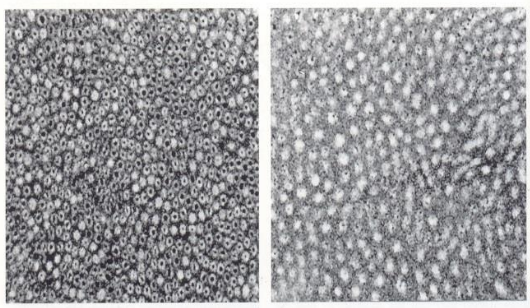


Fig. 5-6. Microradiographs of cross-sectioned dentinal tubules in undemineralized, ground sections from central areas of coronal dentin in a newly erupted premolar (left) and in a premolar from a 71-year-old individual (right).

This reparative dentin seals of the zone of injury occurs as a healing process initiated by the pulp resulting in resolution of the inflammation process and removal of dead cells. The reparative dentine has fewer & more twisted tubules.

Pulp cell changes:

Decrease in number, size, & cytoplasmic organelle.

Fibroblast changes

Fibrosis

a. In aging pulp accumulations of both diffuse fibrillar components as well as bundles of collagen fibers usually appear.

b. Fiber bundle arranged

- longitudinally ---radicular pulp
- diffusely--- coronal pulp

c. Increased in fibers is generalized throughout the pulp organ

d. Collagen increases in medial & adventitial layers of blood vessels

e. Increased in collagen fiber is more apparent than actual because of decreased in size of pulp which makes the fibers to occupy less space.

f. Vascular changes in the aging pulp is same as occur in any other organ like ***plaque calcifications***

Pulp stones /denticles

- They are defined as nodular, calcified masses appearing in either or both the coronal or root portion of pulp organ.
- They are seen in otherwise normal tooth in other respects
- They are seen in functional as well as embedded unerupted teeth

Tooth Loss

- Not a normal part of aging.
- A consequence of oral disease:
    a. Caries
    b. Periodontal disease
    c. Often associated with systemic diseases

Decline in Edentulous Adults, improved and still improving dental health care has led to significant declines in the number of edentulous adults with increased retention of teeth into old age, we are seeing more incidences of caries and other dental diseases in those teeth.

Oral Mucosa with aging

- Epithelium thinner, more fragile, less keratinized
- Loss of collagen and elastin from fibers also weaken mucosa
- Increase in pathological change - loss of tongue papillae and taste buds
- minor salivary glands diminish
- Lesions more common and slower to heal.
- Inflammations, irritation and infections

Tongue

It seems to increase in size in edentulous mouth which may be because of result of transferences of some of the masticatory & phonetic function of the tongue.

Enlarged tongue have negative effect on retention of denture.

- There is depapillation which usually begin at apex & lateral border.
- fissuring is also common.
- There is also reduction in the taste buds

Taste

Reasons for decline in sense of taste are unclear.

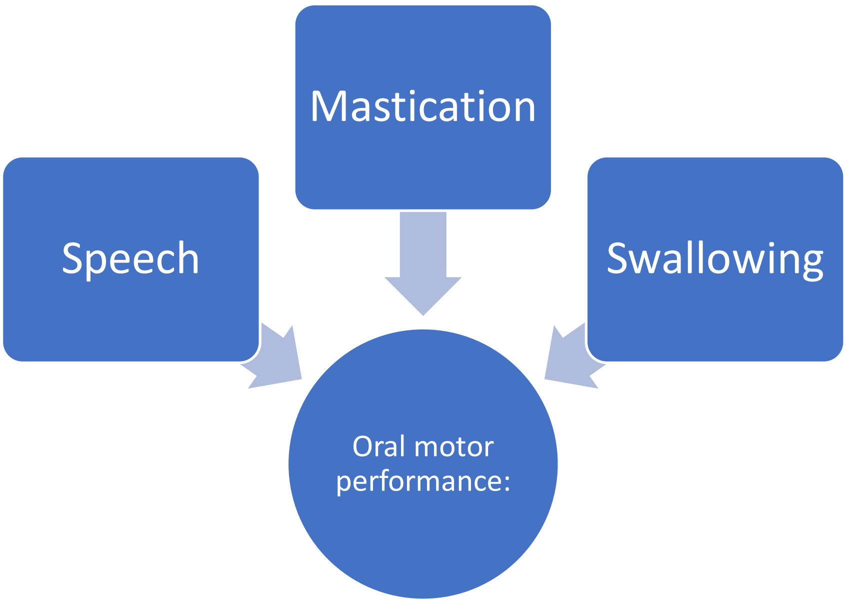
- Possible decline in number of taste buds
- Possible decline in density of taste buds
- Possible decline in sensitivity of taste buds
- Possible decline in neural processing or retrieval

All of the above also possible.

Medications Known to Interfere with Taste

Medications, including the most commonly prescribed, interfere with taste or olfactory senses:

- **Antibiotics:** Ampicillin, Azithromycin (Zithromax), Ciprofloxacin (Cipro) Clarithromycin (Biaxin)
  - Griseofulvin (Grisactin) Metronidazole (Flagyl)
  - Ofloxacin (Floxin) Tetracycline
- **Anticonvulsants:**
  - Carbamazepine (Tegretol)
  - Phenytoin (Dilantin)



• Tissues involved are:

upper lip, lower lip, jaws, tongue, floor of oral cavity, soft palate etc.

Speech

Speech production is most resistant to aging but that does not mean there are no age-related changes in speech.

• You can very well perceive differences when person of old age speaks but these are largely related to laryngeal rather than oral events.

other speech changes may occur due to:

• Edentulous patient (partial or complete)

• ill-fitting prosthesis.

Swallowing

- Reduced chewing effectiveness
- Decreased tongue strength
- Less muscle and an increase in fatty and connective tissue in the tongue.
- Atrophy of the alveolar bone with lost dentition
- Increased swallowing time with age
- Swallowing disorders may be prevalent

Swallowing/oral movement in old age

• People chew slowly as they get older. Although the duration of the total chewing cycle does not seem to change, it does seem that vertical displacement of mandible is shortened.

• Movements of the mandible are governed by a generator in the brainstem & influenced by the proprioception in the muscles, joints, & mucosa.

Age may impair the central processing of nerve impulses, impede the activity of striated muscles & retard the ability to make decisions

- Poor motor coordination & weak muscles.
- Decrease No. of functional motor units, fast muscle fibers & decrease in cross sectional area of masseter & medial pterygoid muscles.
- Muscle tone decrease by 20-25% which probably explains the shorter chewing stroke & prolonged chewing time if it is there.

- Some individuals who assume the characteristic stoop of old age experience pain on swallowing because of osteophtes & spurs growing on the upper spine adjacent to the pharynx.

  Abnormal mandibular movements consequent to teeth loss, use of complete denture, deflective occlusal contacts.

Atrophy of masticatory muscles and masticatory ability and performance **Masticatory ability**:

it is an individual's own assessment of his/her masticatory function

Masticatory efficiency:

it is the capacity to grind the food during mastication

• Essential that masticatory function (in complete denture wearers) be maintained throughout life.

• Masticatory function depends on the skeletal muscular force and the ability to co-ordinate oral functional movements during mastication

• Maximal bite forces decrease in older patients

• Greater atrophy occurs in complete denture wearers especially women.

• Little evidence that new dentures reduce this atrophy

Wearing dentures does compromise masticatory performance greatly as compared to a natural set of teeth.

(1)Prosthodontics

Residual Ridge Resorption (RRR)

Lec.: 20,21 د.صفوان عبد الحميد

Residual bone: that component of maxillary or mandibular bone that remains after the teeth are lost.

Residual ridge: the portion of the residual bone and its soft tissue covering that remains after the removal of teeth

Residual ridge crest: the most prominent continuous surface of the residual ridge, not necessarily coincident with the centre of the ridge;

Residual ridge resorption: is a term used for the diminishing quantity and quality of residual ridge after teeth are extracted. It is a chronic, progressive and irreversible process with the rate being **fastest** in the **first 6 months** after extraction. The size of the residual ridge is reduced most rapidly in the first six months, but the bone resorption activity of the residual ridge continues throughout life at a slower rate, resulting in removal of a large amount of jaw structure. This unique phenomenon has been described as **residual ridge reduction.**

Post tooth extraction, a cascade of inflammatory reactions is immediately activated, and the extraction socket is temporarily sealed by blood clotting. **Epithelial tissues begin** its proliferation and migration within the **first week** and the disrupted tissue integrity is quickly restored. Histologic evidence of **active bone formation in the bottom of the socket** is seen as early as **2 weeks after the extraction** and the socket is progressively filled with newly formed bone in **about 6 months**. The most striking feature of the extraction wound healing is that even after the healing of wounds, the residual ridge alveolar bone undergoes a lifelong catabolic remodelling.

The rate of RRR is different among persons and even at different times and sites in the same person.

A basic concept of bone structure and its functional elements must be clear before bone resorption can be understood. The structural elements of bone are:

a. **Osteocytes:** These are cells responsible for metabolic activity of bone.
b. **intercellular substance or bone matrix** consisting of fibrils or called Calcified cementing substance: The calcified cementing substance consists mainly of *polymerized glycoprotein*. *Mineral salts* namely *calcium carbonate* and *phosphates* are bound to these protein substances.
c. **Osteoblasts:** by their function of forming and calcifying the intercellular substance, are the active bone forming cells. The osteoblasts surround the bone in a continuous layer. In the course of bone formation, some osteoblasts get engulfed in the intercellular substance and become osteocytes.

   The key difference between osteoblasts and osteocytes is that osteoblasts are a type of bone cells responsible for the formation of new bones while osteocytes are a type of bone cells that maintain the bone mass. Bone is a living and growing tissue that makes the skeleton of humans and other vertebrates.
d. **Osteoclasts:** Osteoclasts are the cellular components of bone that are responsible for bone resorption. Bone resorption always requires the simultaneous elimination of the organic and inorganic components of the intercellular substance.

Alveolar bone has **two structural characteristics**. A **hard compact outer layer** is superimposed on a **spongy somewhat resilient substructure**. A healthy and thoroughly healed alveolar process has a layer of wear resistant compact bone of varying thickness. Beneath the compact bone is the spongy bone. The spaces between the trabeculae communicate throughout the spongy bone. Bone is constantly undergoing changes in response to replacement and functional demands.

Pathology of RRR:

1. **Gross Pathology:**

A frequent lay expression for RRR is "My gums have shrunk". Actually, the basic change in RRR is a reduction in the size of the bony ridge under the mucoperiosteum. It is primarily a localized of bone structure. Sometimes it may leave the overlying mucoperiosteum excessive and redundant.

There exists a wide variety of shapes and sizes of residual ridges.

They are categorized into common residual ridge configuration in a system of six orders given by Atwood Order

Order I: Pre-extraction

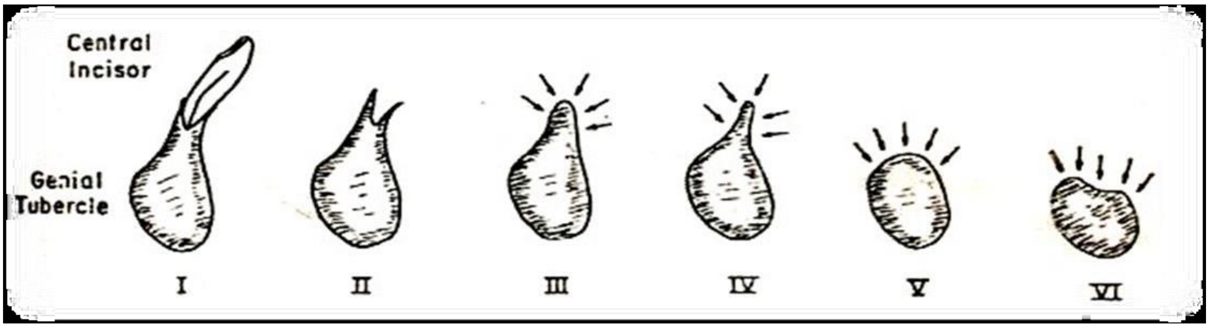
Order II: Post extraction

Order III: High, well rounded

Order IV: Knife-edge

Order V: Low, well rounded

Order VI: Depressed



RRR does not stop with residual ridge, but may go well below where apices of teeth were, sometimes leaving only a thin cortical plate on the inferior border of the mandible or virtually no maxillary alveolar process of the upper jaw. In clinical examination usually one can visually judge the residual ridge form. However, sometimes a knife-edge ridge may be masked by redundant or inflamed soft tissues.

2. **Microscopic Pathology:**

   Microscopic studies have revealed osteoclastic activity on the external surface of the crest of residual ridges. The scalloped margins of Howships lacunae sometimes contain visible osteoclasts which cause bone resorption. There exists a wide variation in the configuration, density and porosity of the residual ridges, sometimes even with evidence of osteoporosis.

Studies have shown the presence of new bone and reversal lines inside the residual ridge and minute areas of bony repair on the periosteal side in some specimens. The mucoperiosteum shows varying degrees of keratinization, acanthosis, oedema and architectural pattern of mucosal epithelium in the same mouth and between subjects. Similarly, varying degrees of inflammatory cells are found in areas that appear from clinically normal to frankly inflamed in edentulous patients or who were denture or non-denture wearers. Inflammatory cells include lymphocytes and plasma cells. There exists proximity of small blood vessels to area of bone resorption.

Pathogenesis of RRR:

Immediately following the extraction (order II), any sharp edges remaining are rounded off by external osteoclastic resorption, leaving a high well rounded residual ridge (order III). As resorption continues from the labial and lingual aspects, the crest of the ridge becomes increasingly narrow ultimately becoming knife-edged (order IV). As the process continues, the knife-edge becomes shorter and even eventually disappears, leaving a low well rounded or flat ridge (order

V). Eventually, this too resorbs, leaving a depressed ridge (order VI). RRR is **chronic**, **progressive**, **irreversible** and **cumulative**.

According to the American college of prosthodontists: Based on Bone Height (Mandible only)

Type I: Residual bone height of **21 mm** or **greater** measured at the least vertical height of the mandible.

Type II: Residual bone height of **16 - 20 mm** measured at least vertical height of the mandible.

Type III: Residual alveolar bone height of **11 - 15 mm** measured at the least vertical height of the mandible.

Type IV: Residual vertical bone height of **10 mm** or **less** measured at the least vertical height of the mandible Direction of bone resorption

- Maxilla resorbs **upward** and **inward** to become progressively **smaller** because of the direction and inclination of the roots of the teeth and the alveolar process.
- The opposite is true of the mandible, which inclines outward and becomes progressively wider.
- This progressive change of the edentulous mandible and maxilla makes many patients appear prognathic.

Thus, RRR is centripetal in maxilla and centrifugal in mandible.

Patterns of bone resorption

In the Mandible, large proportions of bone loss occur in the

- labial side of anterior residual ridge,
- equally on the buccal and lingual side in premolar region and
- lingually in the posterior or molar region.

In the Maxilla bone, loss primarily occurs on the labial or buccal aspect. Therefore, while teeth arrangement we should try to restore the natural position of the teeth before they were lost, Hence

- Teeth in the maxillary arch are arranged slightly labially and buccally.
- While in the mandible, teeth in the anterior region are arranged labially, on the centre of the ridge in the premolar region and slightly lingually in the molar region.

Maxilla V/S Mandible

- It is a clinically acknowledged fact that the anterior mandible resorbs 4 times faster than the anterior maxilla.
- Woelfel et al have cited the projected maxillary denture area to be **4.2 sq inch** and **2.3 sq inch** for the mandible; which is in the ratio of **1.8:1**.
- If a patient bites with a pressure of 50 lbs, this is calculated to be 12 lbs/sq in under the maxillary denture and 21 lbs/sq under the mandibular denture.

The significant difference in the two forces may be a causative factor to cause a difference in the rates of resorption.

- Cancellous bone is ideally designed to absorb and dissipate the forces it is subjected to.
- The maxillary residual ridge is often broader, flatter, and more cancellous than the mandibular ridge.
- Trabeculae in maxilla are oriented parallel to the direction of compression deformation, allowing for maximal resistance to deformation.
- The stronger these trabeculae are, the greater is the resistance.

Consequences of RRR:

a. There is apparent **loss of sulcus width** and **depth**.
b. **Muscle attachments** are displaced closer to the crest of the residual ridge. Due to loss of VDO lower face height is reduced and mandible is rotated anteriorly.
c. Patient may develop **habitual prognathic appearance**.
d. **Inter-alveolar ridge** relationship is altered.
e. **Morphological changes** in residual ridge may appear such as sharp, spiny, uneven residual ridges.
f. **Resorption of the mandibular canal wall** and exposure of the mandibular nerve.
g. **Location of the mental foramina close to the top of the mandibular residual ridge**. This provides serious problems to the clinician on how to provide adequate support, stability and retention of the denture.

Aetiology of RRR:

In equilibrium the two antagonistic actions (of osteoblasts and osteoclasts) are in balance. **Ingrowth**, although resorption is constantly taking place in the remodelling of bones as they grow, increased osteoblastic activity (makes up) more than osteoclasts for the bone destruction. Whereas in **osteoporosis**, osteoblasts are hypoactive, and in the resorption related to hyperparathyroidism, increased osteoblastic activity is unable to keep up with the increased osteoclastic activity.

Ridge resorption varies directly with some systemic or localized bone resorptive factors and inversely with some bone formation factors

$$\mathbf{RRR} \propto \frac{\textbf{bone resorption factors}}{\textbf{bone formation factors}}$$

Systemic factors influence the balance between the normal bone formation and bone resorption. These factors create a natural resistance to unfavourable local factors. They are:

1. Estrogen.
2. Thyroxin.
3. Growth hormone.
4. Androgens.
5. Calcium.
6. Phosphorus.
7. Vitamin D.
8. Protein.
9. Fluoride.

Some local biochemical factors in relation to periodontal disease which affects the ridge resorption-

1. Endotoxins from dental plaque on unclear dentures.
2. Osteoclast activating factor (OAF).
3. Prostaglandins.
4. Human gingival bone resorption stimulating factors.
5. Heparin acts as a cofactor in bone resorption which is produced from mast cells (*play an important role in how the immune system responds to certain bacteria and parasites and they help control other types of immune responses. They contain chemicals such as histamine, heparin, cytokines, and growth factors*).

RRR is a multi-factorial, biomechanical disease that results from a combination of **anatomic**, **metabolic** and **mechanical determinants** (functional and prosthetic).

1. **Anatomic Factors:** these factors include amount of bone and quality of bone.

   Amount of bone: When we clinically examine a completely edentulous foundation, we tend to gauge the residual ridge on the basis of it being high/low, broad/narrow, rounded/spiny, covered by thick/thin mucoperiosteum.

   The rate of vertical bone loss in broad, high ridge may actually be slower than that of a narrow ridge because there is more bone to be resorbed per unit of time and because the rate of resorption also depends on the density of the bone.

   Quality of bone: On theoretic grounds, the denser the bone, the slower the rate of resorption because there is more bone to be resorbed per unit of time.

2. **Metabolic factors:** it includes both nutritional disturbances and hormonal causative factors.

   a. Hormonal Factors:

1. **Pituitary Glands and Hypophysis**

   The hypophysis is the master gland of the endocrine system. The control of the hypophysis over the endocrine system is complex and problems of dysfunction require the analysis of an endocrinologist. Such findings are of importance to the dentist because they involve the general health of the patient, which is reflected in the oral cavity.

2. **Thyroid Glands**

   They are responsible for the regulation of the rate of metabolism. Hyperthyroidism increases the metabolic rate leading to negative nitrogen balance. Such a balance is equivalent to protein deficiency, which can be a direct cause of osteoporosis. Thyroxin also has a direct influence on the kidneys, causing an increased excretion of calcium and phosphorus. This depletion of calcium and phosphorus results in decreased bone apposition and increased osteoclastic activity.

3. **Parathyroid Glands**

   Parathormone maintains blood calcium by mobilizing it from the bones through osteoclastic activity.

4. **Islets of Langerhans**

   The failure of these glands to produce sufficient insulin for proper utilization of glucose causes diabetes mellitus. The syndrome of poor healing, low tissue tolerance and rapid resorption of bone is associated with the diabetic patient. In the absence of insulin, a relative nitrogen starvation occurs from increased gluconeogenesis with the amino acids being diverted from protein synthesis. A diabetic controlled by either insulin or diet is not affected by this mechanism. Since perfect control is rarely possible, a word of caution and explanation to diabetic patients is necessary so that they can appreciate their prosthetic difficulties.

5. **Suprarenal Glands**

   The adrenal cortex produces steroid hormones called corticoids. Cortisone and related steroids are antianabolic. It may induce the formation of glucose from carbohydrates and may increase the calcium loss by direct effect on calcium excretion. The prolonged use and administration of such steroids are considered very dangerous to bone tissue. However, one of the beneficial effects of corticoids is to control the defence mechanism of inflammation.

6. **Gonads**

   In general, the sex hormone (androgens and estrogens) promotes a protein anabolic action on all tissues including bone. A moderate amount of osteoporosis accompanies senescence because of the increased catabolic action reflected by atrophic and degenerative changes throughout the body. The ageing person produces decreased amounts of androgens and estrogens, which results in faulty protein metabolism for tissue repair. The bone matrix suffers and normal bone loss cannot be compensated.

b. Dietary Factors: Food is classified as proteins, carbohydrates, fats, vitamins and inorganic elements.

1. Protein

Protein is necessary to build and maintain tissue and to supply energy. The synthesis of osteoid tissue in protein starved people is compromised and calcification is decreased since the protein matrix is embarrassed. Protein may not be available because of inadequate intake, improper assimilation or excessive loss as in nephrosis or because it is utilized as calorie requirements because of hyperthyroidism/ uncontrolled diabetes.

Inadequate incorporation of protein in diet (3 ounces/ day) will cause slow growth of bone. Bone apposition cannot keep up with normal osteoclastic activity and a negative bone factor exists.

2. Vitamins

The action of vitamins in many respects is said to be same as that of hormones. The relationship of vitamins and hormones can be explained on the basis that the endocrine glands produce intrinsic hormones and the vitamins are extrinsic hormones.

Vitamin A:

A deficiency of vitamin A may result in poor development and calcification of bone. Prolonged deficiency of vitamin A causes renal damage by hornification of tubules, which then lose the capacity to reabsorb phosphorus. The imbalance of the calcium:phosphorus ratio leads to osteoporosis.

Vitamin B complex:

The total effect of vitamin B complex is of a regulatory nature. Hypovitaminosis B results in loss of appetite, dietary insufficiency, increase in nervous irritability resulting in lowered resistance to stress and emotional tension. The total well-being of the individual is impaired.

Vitamin C:

Lack of vitamin causes decalcification of the bone and has been held responsible for diffuse alveolar atrophy. The apposition of new bone slows down dramatically because osteoblastic activity is impaired. The collagen content of bones is also reduced in vitamin deficiency. The periosteum thickness and the cells appear immature and resemble fibroblasts. This condition may make the periosteum easily prone to injury by the denture base. Osteophytes appear as a result of avitaminosis C. The rapid loss of bone and the increased inflammation of the mucoperiosteum cause the development of these bony outgrowths.

Vitamin D:

It is necessary for the calcium:phosphorus balance to remain within tolerable limits. Vitamin D would be unnecessary if the exact required ratio of calcium and phosphorus were available in the diet. When bone loses its ability to calcify the matrix, administration of vitamin D will cause calcification and denser bone. Moderate overdosage causes excessively mineralized bone, but gross overdosage causes bone resorption. Many drugs act as vitamin antagonists. These drugs act largely on vitamin C and B complex and their excessive use may cause a marked vitamin deficiency.

Some of the common vitamin inhibitors are nicotine, alcohol, barbiturates, morphine, some of the sulfa drugs and some of the antibiotics such as streptomycin and penicillin.

3. **Carbohydrates (Starch and Sugars)**

   They provide the chief source of energy. They are related only indirectly to bone resorption through association with diabetes and by substitution for more favourable foods.

4. **Fats and Organic Substances**

   They are those, which yield heat and energy and only secondarily build/repair tissue.

5. **Inorganic Elements**

   Calcium salts (calcium carbonate and calcium phosphate) form the rigid supporting structure of bones. Phosphorus in the form of calcium and magnesium phosphate, gives hardness to bone. Abnormalities of the calcium phosphorus elements of the blood stream may be associated with alveolar resorption or rarefaction.

   The body requires **0.7 gm** of calcium/day, which can be obtained from 1 quart of milk. Other sources of calcium are dairy products, spinach, oranges, celery, chard, carrots and lettuce. The phosphorus need is about **1.5 to 3 gm** daily dependent upon the form. Dry beans, milk, cheese, leafy vegetables, celery and carrots may fulfil these requirements.

Edentulous patients should follow a prescribed dietary regimen. This diet should be **low in carbohydrates** and **high in protein intake**. The diet should include at least a quart of milk or substitute dairy products, vegetables, fruits and a multiple vitamin supplement. The normal equilibrium may be upset and pathologic bone loss may occur if either bone resorption is increased or bone formation is decreased, or if both occur.

- Since bone metabolism is dependent on cell metabolism, anything that influences cell metabolism of osteoblasts and osteoclasts is important.
- The thyroid hormone affects the rate of metabolism of cells in general and hence the activity of both, the osteoblasts and osteoclasts.
- Parathyroid hormone influences the excretion of phosphorous in the kidney and also directly influences osteoclasts.
- The degree of absorption of Ca, P and proteins determines the amount of building blocks available for the growth and maintenance of bone.

- Vit. C aids in bone matrix formation.
- Vit. D acts through its influence on the rate of absorption of calcium in the intestines and on the citric acid content of bone.
- Various members of Vit. B complex are necessary for bone cell metabolism.
- In general terms, anabolism exceeds catabolism during growth and convalescence, levels off during most of adult life and is exceeded by catabolism during disease and old age. Bone has its own specific metabolism and undergoes equivalent changes. At no time during life is bone static, but rather it is constantly rebuilding, resorbing and remodelling subject to functional and metabolic stresses.

Osteoporosis and residual ridge modelling:

The clinical and pathophysiologic views of osteoporosis has been refined recently to the concept of Type I and II osteoporosis.

Type I osteoporosis: is defined as the specific consequence of menopausal estrogen deprivation, and characteristically presents the bone mass loss, notably in the trabecular bone.

Type II osteoporosis: reflects a composite of *age-related change* in *intestinal*, *renal* and *hormonal function*. Both **cortical** and **trabecular bone** are affected in Type II osteoporosis.

3. **Mechanical factors**:

a. **Functional Factors:**

Functional factors include the **frequency**, **intensity**, **duration** and **direction** of forces applied to bone which are translated into cellular activity, resulting in either bone formation or bone resorption, depending upon on the patients' individual resistance to these forces.

Wolff's law postulates that all changes in the function of bone are attended by definite alterations in its internal structure. Forces within physiologic limits of bone are beneficial in their massaging effect. On the other hand, increased or sustained pressure, through its disturbance to the circulatory system, produces bone resorption. The amount and frequency of stress and its distribution and direction are important factors in treatment planning. Although the total amount of the necessary masticatory stress cannot be diminished, increasing tissue coverage and decreasing the length and width of the occlusal table may lessen the load/unit area.

The frequency of stress application modifies the reaction of alveolar bone to external forces. Constant pressure on bone causes resorption, while intermittent forces favour bone formation. Since recurrent forces over short intervals of time have essentially the same resorbing effect as constant pressure, a rest period between meals is beneficial. For this reason, the patient should be warned that gum chewing has a destructive effect on the bone.

Bruxism is an expression of nervous tension, which manifests itself as gnashing, grinding or clenching of the teeth while the patient is asleep or awake. Since most denture patients do grind their teeth in sleep, the dentures should not be worn during this period. Thus, the supporting structures are afforded the rest period essential to the maintenance of the alveolar bone. While grinding of the teeth when the patient is awake may be a habit of tension, it may also be caused due to lack of interocclusal distance.

The principal concern should be in the pattern and position of the posterior teeth. **There are two mandibular movements associated with mastication:**

a *closing/cutting movement* and a *lateral or grinding movement*. A sharp cusp will penetrate a bolus of food with less force than a flat occlusal form. However, a law of physics explains that forces applied to an inclined plane produce a resultant force or vector perpendicular or right angles to the plane. Applying this principle to occlusal form, the resultant force of the steep incline of high cusps would produce a lateral force, which might cause alveolar resorption.

Stress distribution favourable to healthy alveolar bone maintenance is dependent principally upon bilateral balanced occlusion. Balanced occlusion is that arrangement of the teeth, which will permit the necessary mandibular movements without tending to dislodge the denture or traumatize the supporting structure

b. Prosthetic Factors:

The prosthetic factors are extremely difficult to evaluate because of tremendous number of variables, including **anatomic**, **metabolic** and **functional factors**. The traditional design of dentures includes many features whose goal is to reduce the amount of force to the ridge and to thereby reduce RRR.

These prosthetic factors include:

- broad-area coverage (to reduce the force per unit area);
- decreased number of dental units,
- decreased bucco-lingual width of teeth, and improved tooth form (to decrease the amount of force required to penetrate a bolus of food);
- avoidance of inclined planes (to minimize dislodgement of dentures and shear forces);
- centralization of occlusal contacts (to increase stability of dentures and to maximize compressive forces);
- provision of adequate tongue room (to increase stability of denture in speech and mastication);
- adequate inter-occlusal distance during rest jaw relation (to decrease the frequency and duration of tooth contacts).

Treatment and Prevention of RRR:

The best way to manage the problem of residual ridge resorption is by using every means to prevent it.

a) **Prevention of loss of natural teeth:** Clinicians must try to retain residual roots whenever feasible.

b) **Proper design of dentures and maintenance**.

- ❖ Optimal tissue health prior to making impression.
- ❖ Impression procedures
  - ✓ Minimal pressure impression technique.
  - ✓ Selective pressure impression technique: places stress on those areas that best resist functional forces.
  - ✓ Adequate relief of non-stress bearing areas e.g., Crest of mandibular ridge.
- ❖ Broad area of coverage helps in reducing the force/unit. (Snow Shoe Effect) increased denture bearing area can greatly reduce the load per unit area on the underlying mucosa and improve denture comfort, always assuming that the OVD is not excessive.
- ❖ Avoidance of inclined planes to minimize dislodgment of Avoidance of inclined planes to minimize dislodgment of dentures and shear forces.
- ❖ Centralization of occlusal contacts to increase stability and maximize compressive forces.
- ❖ Provision of adequate tongue room to improve stability of denture in speech and mastication.
- ❖ Adequate interocclusal distance during jaw rest to decrease the frequency and duration of tooth contact.

  Correcting the occlusal vertical dimension: Clinical studies have shown increased (excessive) OVD to be a common fault in many dentures. Guidelines suggest 2-5 mm of freeway space, but this may need to be increased in order patients or for those patients with atrophic mucosa overlying the residual ridges.

- ❖ Occlusal table should be narrow.

The concept and arrangement of teeth in neutral zone helps the teeth to occupy a space determined by the functional balance of the orofacial and tongue musculature. Eliminating disruptive occlusal contacts, which lead to denture in stability.

In general, occlusal tables tend to be too large. This leads to problems of support and stability, which put too much pressure on the atrophic mucosa during function.

- ❖ Overdentures help minimize ridge resorption and contribute to enhance retention stability, support of prosthesis along with preservation of proprioception.
- ❖ The introduction of dental implants has revolutionized clinical practice. Use of implants for providing implant supported or implant assisted prosthesis also helps avert continuing residual ridge resorption.

Reducing the forces required to drive the denture teeth through the bolus of food:

This may be achieved by either increasing the denture bearing area or reducing the size and altering the morphology of the occlusal table.

1. **Increasing the denture bearing area**:

The smaller the size of the fitting surface of the denture, the greater are the loads applied to the underlying mucosa. In such cases, the denture bearing area may be increased using green stick impression compound before relining or by using a chair-side relining material prior to the denture being relined conventionally.

2. **Reducing the size and altering the morphology of the occlusal table.**

c) **Nutrition**

- It has been seen that one of the cofactors in RRR is low calcium and vitamin D metabolism.
- Diet counselling for prosthodontic patients is necessary to correct imbalances in nutrient intake.
- Denture patients with excessive RRR report lower calcium intake and poorer calcium phosphorus ratio, along with less vitamin D.

d) **Preprosthetic surgery:**

- Excessive RRR leads to loss of sulcus width and depth with displacement of muscle attachment more to the crest of residual ridge.
- Osseous reconstruction surgeries, removal of high frenal attachments, augmentation procedures, vestibuloplasties etc., may be required to correct these conditions.

e) **Immediate dentures:** Some authors claim that extraction followed by immediate dentures reduces the ridge resorption.

f) **Overdentures:** Tooth supported overdentures help in improved stress distribution there by maintaining the integrity of residual ridge.
A study was conducted with overdentures supported by canines and it was seen that, the bone loss was 0.6mm whereas 5mm in conventional complete dentures.

g) **Osseointegration and implant**

Precautions during extraction to reduce RRR When a tooth is removed the labial plate should be preserved.

- The labial periosteal covering should remain intact as its inner layer is responsible for remodelling of bone.
- If a bone has to be removed it must be the palatal plate.

IMPORTANT NOTES:

1. Reduction of residual ridges (RRR) needs to be recognized for what it is: a major unsolved oral disease which causes physical, psychologic, and economic problems for millions of people all over the world.

2. RRR is a chronic, progressive, irreversible, and disabling disease. At the present time, the relative importance of various cofactors is not known.

3. Much is known about the pathology and the pathophysiology of this oral disease, but we need to know much more about its pathogenesis, epidemiology, and aetiology.

4. The ultimate goal of research of RRR is to find better methods of prevention or control of the disease. Because prevention is the key.

Implant Prostheses

Lec.22,23 **د.صفوان عبد الحميد**

Osseointegration is a direct bone anchorage of an implant body, which can provide a foundation to support prosthesis. **Dr. Per-Ingvar Brånemark**, Sweden Professor developed the concept of osseointegration and coined the term. In his study, microcirculation, Prof. Brånemark surgically inserted the titanium chamber into the tibia of a rabbit. The initial concept of Osseointegration stemmed from vital microscopic studies. Then studies that followed involved titanium implants placed into jaws of dogs.

Oral Implantology (Implant Dentistry):

It is the science and discipline concerned with the diagnosis, design, insertion, restoration and/or management of **alloplastic** or **autogenous** oral structures to restore the loss of contour, comfort, function, aesthetics, speech and/ or health of the partially or completely edentulous patient.

Implant Prosthodontics: It is the branch of implant dentistry concerning the restorative phase following implant placement and the overall treatment plan component before the placement of dental implants.

It is the phase of prosthodontics concerning the replacement of missing teeth and/or associated structures by restorations that are attached to Dental Implants.

Implant: Any object or material, such as an alloplastic substance or other tissue, which is partially or completely inserted or grafted into the body for therapeutic, diagnostic, prosthetic or experimental purposes.

Implant Prosthesis: Any prosthesis (fixed, removable or maxillofacial) that utilizes dental implants in part or whole for retention, support and stability.

Implant System: Dental implant components that are designed to mate together. An implant system can represent a specific concept, inventor, or patent.

It consists of the necessary parts and instruments to complete the implant body placement and abutment components.

Osseointegration: The apparent direct attachment or connection of osseous tissue to an inert, alloplastic material without intervening connective tissue.

Direct bone anchorage to an implant body, which can provide a foundation to support prosthesis (Brånemark, 1983).

A direct structural and functional connection between ordered living bone and the surface of a load carrying implant (Albrektsson et al., 1981).

Endosseous Implant/Endosteal Implant:

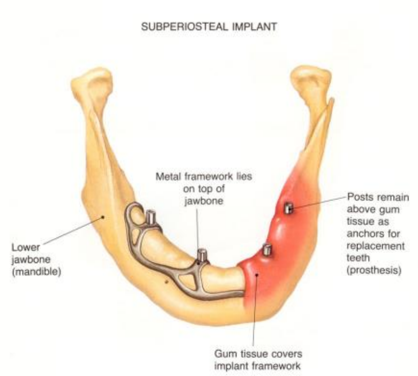
A device placed into the alveolar and/basal bone of the mandible or maxilla and transacting only on cortical plate.

A device inserted into the jaw bone (endosseous) to support a dental prosthesis. It is the 'tooth root' analogue and is often referred to as fixture (Richard Palmer).

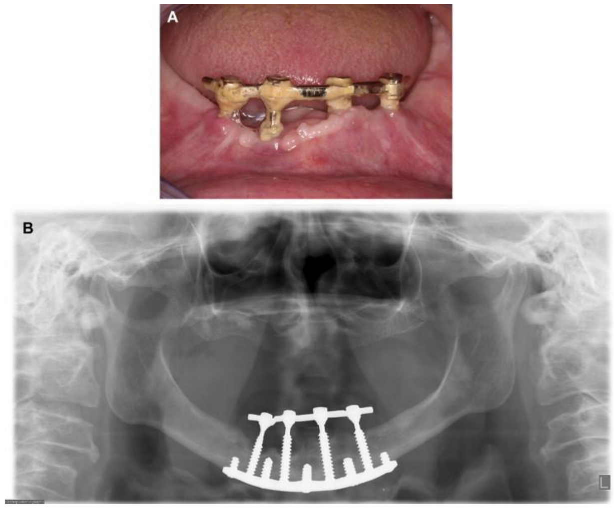
Implant classification

Dental implant can be classified depending on placement within tissue:

- **Subperiosteal:** A CoCr casting custom made for an edentulous bony ridge and placed subperiosteally with integral trans-mucosal posts for denture retention.



- **Transmandibular (transosseous) dental implants "staple bone plates"** The staple bone plate is used to rehabilitate the atrophic edentulous mandible. It is a transosteal threaded posts which penetrate the full thickness of the mandible and pass into the oral cavity in the parasymphysial area.



- **Submucosal implants:** A small "press stud-like" device within the soft tissue helping to retain a denture, usually maxillary
- **Transdental fixation:** A metal implant placed through a tooth and extended through the root canal into the periapical bone to stabilize the mobile tooth sometimes referred to as endodontic implants This was first used by Cuswell and Senia in 1983.
- **Endosseous-blade (plate), ramus frame, transosteal or staple, root form, or cylindrical:** These implants are anchored in bone and penetrate the oral mucosa to provide prosthetic anchorage.

1. **Classification of endosseous implants according to their design:**

a. Cylinders endosseous implants.

b. Screws or spiral post endosseous implants.

c. Blade form endosseous implants.

d. Root form endosseous implants

2. **Classification of endosseous implants according to their material:**

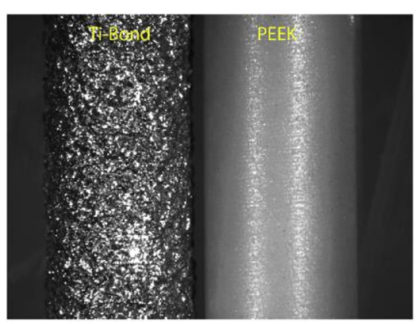
a. Pure titanium: the titanium oxide surface was responsible for the formation of the direct bone- implant interface.

b. Titanium alloy: the titanium alloys exist in three forms: alpha, beta and alpha beta phases and they all originate when pure titanium is heated and mixed with aluminium and vanadium.

3. **Classification of endosseous implants according to surface characteristics:**

a. Sand blasted surface.

b. Titanium Plasma Sprayed surface (TPS), it has satisfactory results regarding the osseointegration and the clinical prognosis.



c. Titanium oxide surface coating the implants to make the inert metal a bioactive one.

d. Hydroxyapatite coating

4. **Classification of endosseous implants according to the insertion technique:**

   The insertion techniques of endosseous implants have been classified into either:

   a. **Press fit technique**, in this type of unthreaded implants, the implant site is drilled slightly smaller than the actual implant size, where the implant is pressed into the recipient site with slight friction.
   b. **Self-tapping technique**, in this type of threaded implants, the implant threads are used to tap its site during insertion.
   c. **Pre-tapping technique**, in case of very dense bone, the implant sites are better to be previously tapped using the bone tap instrument before insertion of the threaded implant

5. **Classification of endosseous implants according to surgical stages:**

   a. **Single stage design (none submerged – transgingival):** the body of the implant is inserted into the bone with its abutment portion penetrating through the mucoperiosteum during the healing period. Surgical placement of a dental implant, which is left, exposed to the oral cavity following insertion. This is the protocol used in non-submerged implant systems
   b. **Two stage design:** in this design the implant body is completely embedded in bone for complete osseointegration. The implant body is then exposed and the healing abutment is placed for soft tissue healing before the impression is made for prosthesis fabrication.

6. **Classification of endosseous implants according to the time of installation:**

a. **Immediate implants**, they are placed into a prepared extraction socket following tooth extraction.

b. **Immediate delayed implants**, they are placed within 6-12 weeks after the tooth loss.

c. **Delayed implants**, they are placed within 6-12 months after tooth extraction, when complete healing and bone remodeling occur

7. **Classification of endosseous implants according to time of prosthetic loading:**

   a. **Immediately loaded implants**, an acrylic resin prosthesis which is designed to be out of occlusion is placed immediately after implant placement, especially in anterior region for aesthetic purposes.

   b. **Delayed loading implant,** delayed loading is done in maxillary implants after 4-6 months and in mandibular implants after 3-4 months to allow for better osseointegration due to the difference of the investing bone composition

Implantology Biomechanics

The initial treatment plan for implant dentistry should include the ideal implant size based primarily on biomechanics and aesthetic considerations. In traditional prosthetics, when a tooth is replaced, the abutment teeth are already provided by nature with wide posterior abutments for posterior teeth. When teeth are replaced with dental implants, the implant team should preselect the ideal implant size based on the ideal aesthetic restoration within biomechanical guidelines.

Historically, the size of an implant was determined primarily by the existing bone volume in height, width, and length. The surgeon would select longer implants in the anterior regions of the mouth and shorter ones in the posterior areas (or use cantilevered prostheses) because of the limits of the mandibular canal and maxillary sinus. The width of the implant, also determined during surgery, would relate to the existing width of available bone, and one diameter implant (4 mm) would be used in most all situations.

Over the years, dental implant treatment plans incorporating biomechanics have been advocated by the author to decrease the most common complications those related to biomechanical stress. The prosthesis first is planned, including whether the restoration is fixed or removable, how many teeth are replaced, and the esthetic demands. The patient force factors are then considered to evaluate the magnitude and type of force applied to the restoration. The bone density is evaluated in the regions of the potential implant placement. The key implant positions are determined followed by the additional implant number based on the patient force factors and the bone density in the implant sites. The key implant positions are important regardless of the patient force factors and bone density. The total implant number, on the other hand, is directly related to these force factors and bone density. For example, more implants should be used when the patient has parafunction or the bone is less dense because the greater force exerted on the implant abutments will transmit greater stresses to the implant bone interface. In fact, implant number may also be a factor when the ideal size of the implant is inadequate for the biomechanical load. The next consideration in this ideal treatment plan sequence is the implant size.

Treatment Plan Sequence:

1. **Prosthesis**
2. **Key implant position**
3. **Patient force factors**
4. **Bone density**
5. **Implant size**
6. **Implant number**

Prosthesis

Prosthodontic Classification (Misch Classification)

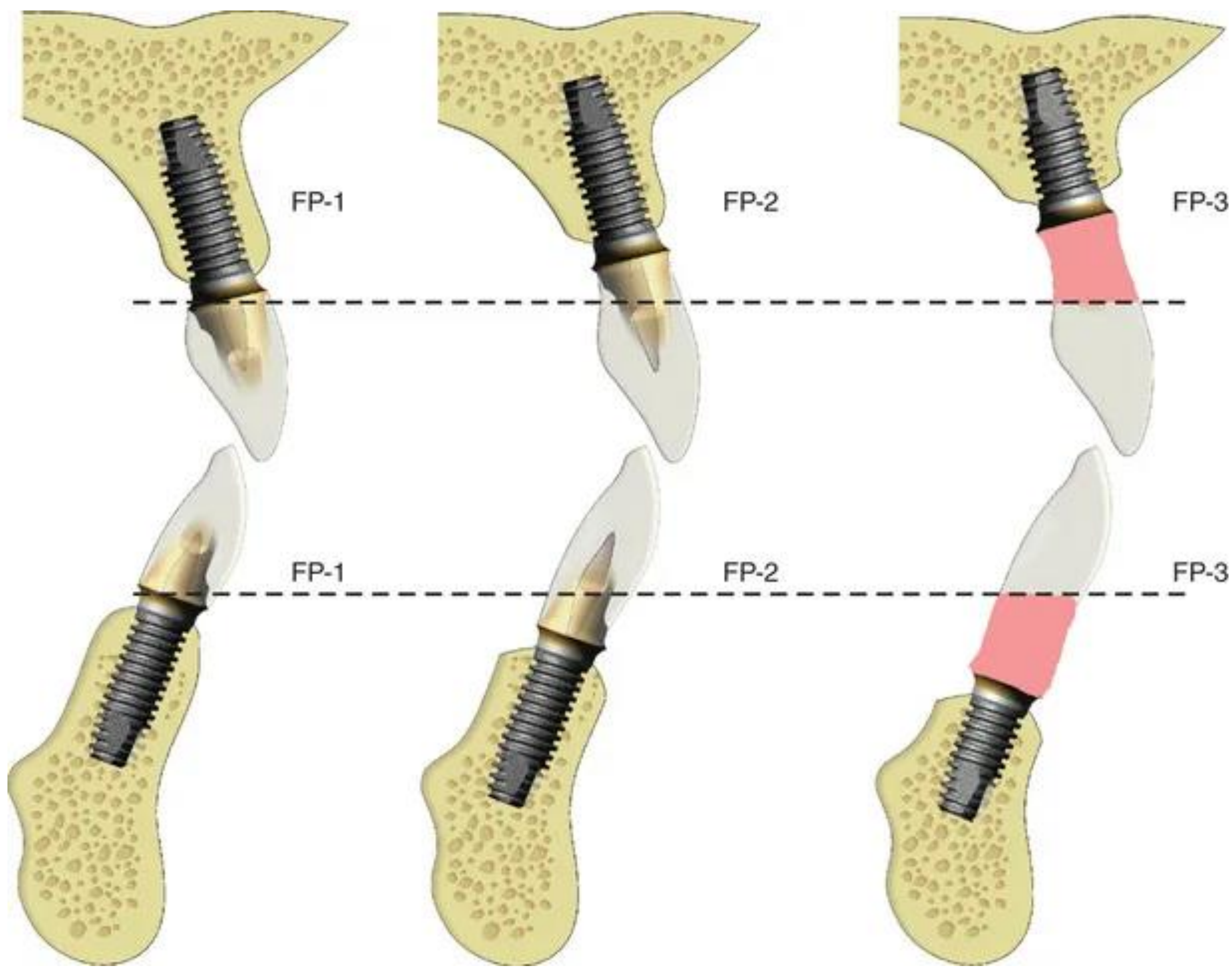
FP-1 Fixed prosthesis: *replaces only the crown; looks like a natural tooth.* An FP-1 is a fixed restoration and appears to the patient to replace only the anatomical crowns of the missing natural teeth. To fabricate this restoration type, there must be minimal loss of hard and soft tissues. The volume and position of the residual bone must permit ideal placement of the implant in a location similar to the root of a natural tooth. The final restoration appears very similar in size and contour to most traditional fixed prostheses used to restore or replace natural crowns of teeth.

FP-2 Fixed prosthesis: *replaces the crown and a portion of the root; crown contour appears normal in the occlusal half but is elongated or hypercontoured in the gingival half.*

An FP-2 fixed prosthesis appears to restore the anatomical crown and a portion of the root of the natural tooth. The volume and topography of the available bone are more apical compared with the ideal bone position of a natural root (1–2 mm below the cement–enamel junction) and dictate a more apical implant placement compared with the FP-1 prosthesis. As a result, the incisal edge of the restoration is in the correct position, but the gingival third of the crown is overextended, usually apical and lingual to the position of the original tooth. These restorations are similar to teeth exhibiting periodontal bone loss and gingival recession.

FP-3 Fixed prosthesis: *replaces missing crowns and gingival color and a portion of the edentulous site; prosthesis most often uses denture teeth and acrylic gingiva but may be porcelain to metal.*

The FP-3 fixed restoration appears to replace the natural teeth crowns and has pink coloured restorative materials to replace a portion of the soft tissue, especially the interdental papillae. As with the FP-2 prosthesis, the original available bone height has decreased by natural resorption or osteoplasty at the time of implant placement. To place the incisal edge of the teeth in proper position for aesthetics, function, lip support, and speech, the excessive vertical dimension to be restored requires teeth that are unnatural in length. However, unlike the patient requirements for an FP-2 prosthesis, the patient may have a normal to high maxillary lip line during smiling or a low mandibular lip line during speech. As a consequence, the soft tissue drape should also be replaced. Prosthetic replacement of the soft tissue drape (FP-3 prosthesis) is most often desirable when multiple adjacent teeth are missing.



RP-4 Removable prosthesis: *overdenture supported completely by implants (usually with a superstructure bar).*

RP-4 is a removable prosthesis completely supported by the implants, teeth, or both. The restoration is rigid when inserted: overdenture attachments usually connect the removable prosthesis to a low-profile tissue bar or superstructure that splints the implant abutments. Usually, five to seven implants in the mandible and six to eight implants in the maxilla are required to fabricate completely implant supported RP-4 prostheses in patients with favourable dental criteria.

RP-5 Removable prosthesis: *overdenture supported by both soft tissue and implants (may or may not have a superstructure bar).*

RP-5 is a removable prosthesis combining implant and soft tissue support. The amount of implant support is variable. A completely edentulous mandibular overdenture may have

(1) two of three anterior implants independent of each other primarily for retention;

(2) splinted implants in the canine regions to enhance retention and stability,

(3) three splinted implants in the premolar and central incisor areas to provide improved retention and lateral stability; or

(4) four or five implants splinted with a cantilevered bar to improve retention, stability, and support which reduces soft tissue abrasions and limits the amount of soft tissue coverage needed for prosthesis support. The primary advantage of an RP-5 restoration is the reduced cost because fewer implants may be inserted compared with a fixed restoration and there is less demand for bone augmentation, often required for additional implants. The prosthesis is very similar to traditional overdentures supported by natural teeth.

An RP-5 restoration has primarily anterior implant support and posterior soft tissue support in the maxilla or mandible. Often fewer implants are required and bone grafting is less indicated.

Key implant position

The key implant positions are determined with no limitations. In other words, the radiograph is used for diagnosis to determine the prosthesis and pathology but not the available bone and implant position. Rather, the dentist "pretends" the patient has all the available bone necessary to place the implant in the key sites, the patient has no financial limitations to do the ideal treatment, time is not an issue related to treatment, and the skill necessary to place (or augment and place) an implant in the key sites is present by the dentist or the referring team.

There are four general guidelines to determine key implant positions for a fixed prosthesis in the edentulous site with multiple adjacent teeth missing:

1. Cantilevers on prostheses designed for partially edentulous patients or complete edentulous maxillae should preferably be eliminated; therefore, the terminal abutments in the restoration are key positions.

2. Three adjacent pontics should not be designed in the prosthesis, especially in the posterior regions of the mouth.

3. When the canine is missing, the canine site is a key position, especially when other adjacent teeth are missing.

4. When the first molar is missing, the first molar site is a key implant position for all partially edentulous patients and completely edentulous maxillae.

Character of Forces Applied to Dental Implants

Stress and Strain

The presence of fibrous tissue has long been known to decrease the long-term survival of a root form implant. Excessive loads on an osseointegrated implant may result in mobility of the supporting device even after a favourable bone–implant interface has been obtained. Excessive loads on the bone result in increased strain conditions in the bone. These microstrains in the bone may affect the bone remodelling rate and cause pathologic overload, which results in the loss of bone. The amount of bone strain is directly related to the amount of stress applied to the implant–bone interface. The **stress** may cause **complete implant failure**, **porcelain fracture**, **uncemented restorations**, **abutment screw loosening**, **implant and component fracture**, and **crestal bone loss**. Although several conditions may cause crestal bone loss, one of these may be prosthetic overload. The greater the stresses throughout the implant–bone interface, the greater the risk factor for any biomechanical complication, including crestal bone loss and implant failure. Therefore, the stress and strain relationship has been shown to be an important parameter to decrease any biomechanical complication.

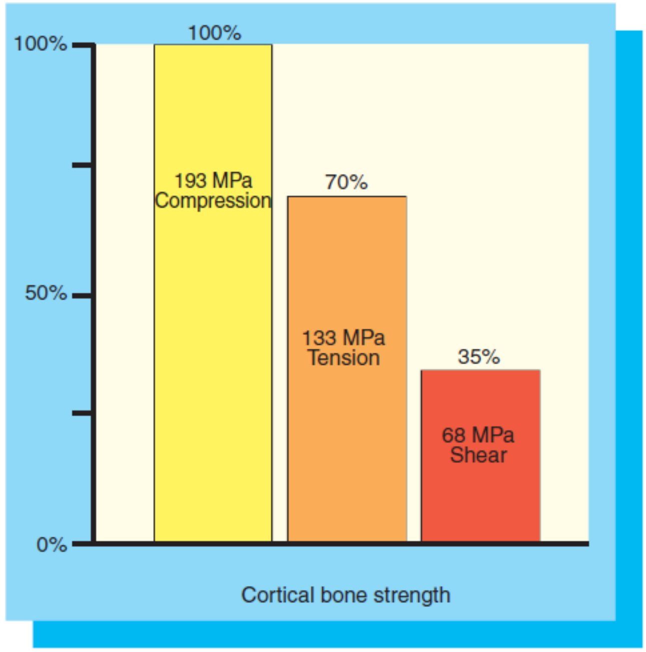


Figure 9-1 Bone is strongest under compression forces, 30% weaker to tensile forces, and 65% weaker to shear forces.

Force Magnitude

The physiology of the stomatognathic system imposes a range on the magnitude of forces that may be applied to an implant in the oral environment. The magnitude of bite force varies as a function of anatomical region and state of the dentition. Average bite forces can range from 10 to 350 lb. The magnitude of force is greater in the molar region (200 lb), less in the canine area (100 lb), and least in the anterior incisor region (25–35 lb). These average maximum bite forces increase with parafunction to magnitudes that may approach 1000 lb in the posterior regions.

Force Duration

The duration of bite forces on the dentition has a wide range. Under ideal conditions, the teeth come together during swallowing and eating for only brief contacts. The total time of these brief episodes is less than 30 minutes per day. Patients who exhibit bruxism, clenching, or other parafunctional habits, however, may have their teeth in contact for several hours each day. Fatigue fractures increase in direct relationship to the amount of the force and the number of cycles of load. Therefore, an increase in force duration directly increases the risk of fatigue load to the implant body when the force is higher than the endurance limit of these entities.

Force Type

Three types of forces may be imposed on dental implants within the oral environment: compression, tension, and shear. Bone is strongest when loaded in compression, 30% weaker when subjected to tensile forces, and 65% weaker when loaded in shear. Therefore, an attempt should be made to limit shear forces on bone because it is least resistant to fracture under these loading conditions. This is most important in regions of decreased bone density because the strength of bone is also directly related to its density. An increased width of an implant may decrease offset loads and increase the amount of the implant–bone interface placed under compressive loads. Hence, when forces are more tensile or shear in nature (as with cantilevers or angled loads), the implant diameter or implant number should be increased to compensate for the weakened bone state.

Force Direction

The direction of the load has a significant effect on the magnitude of compressive and lateral load components (tension and shear forces). Angled loads increase the amount of shear loads transmitted from the implant body to the bone, and the bone is weakest to shear-type loads. By increasing the angle of the load by only 15 degrees, the lateral component of that load (shear and tensile forces) is increased by 25.9%. Every degree of angled load increases the shear load component to the implants, which is the most damaging component of the load because the bone is weakest to shear. The forces to an implant body are typically greatest at the crestal bone interface. Angled loads to the implant prosthesis produce angled loads to the crest module of the implant and hence the marginal bone; therefore, the implant angulation is important to consider.

Under ideal conditions, the implant body should be oriented to provide long-axis compressive loads to the implant and to decrease shear loads to the crestal bone region.

Force Magnification

Force magnification further increases the stress beyond the usual conditions of load (e.g., a cantilevered prosthesis with a crown height greater than normal, an angled load, or parafunction). Multiple force magnifiers, such as a patient with parafunctional habits and an excessive crown height, may exceed the capability of any dental implant to withstand occlusal loads. Careful treatment planning with special attention to the implant position, implant number, occlusal loading, and an increase in implant size to increase functional surface area is indicated when a clinical case presents the challenge of force magnifiers.

Surface Area

The surface area over which the occlusal forces are applied to the implant system is very relevant and is inversely proportional to the stress observed within the implant system (Stress = Force/ Surface area). It can be clearly seen from this basic engineering equation, to reduce stress, the force must decrease or the surface area must increase. Therefore, an increase in implant size is beneficial to decrease the stress applied to the system. The size of an implant may be modified in either length or diameter.

Implants Number

One Missing Tooth

When one tooth is replaced with an implant, the implant should be inserted into the mesiodistal centre of the site.

Two Missing Teeth

When two adjacent teeth are missing, two implants should support the implant restoration.

Three Missing Teeth

When three adjacent teeth are missing, the key implant positions include the two terminal abutments, one on each end of the prosthesis. A three-unit prosthesis may be fabricated with only these abutments when most of the force factors are low to moderate and the bone density is favourable.

Four or More Adjacent Teeth Missing

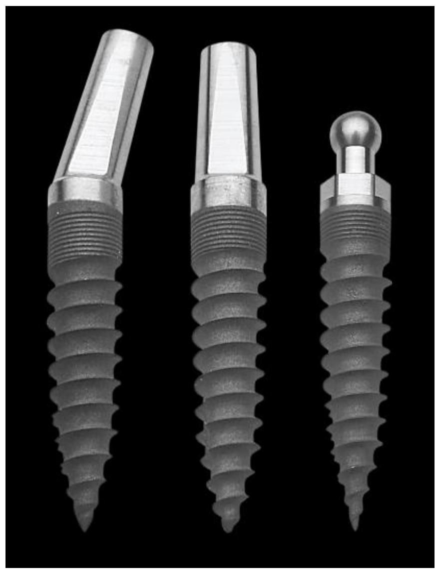
When four adjacent teeth are missing, the terminal abutments are the key implant positions. Most often, an additional implant is required, especially when the missing teeth include a canine or posterior teeth or when the bone density is poor. Restorations of five to 14 units require the key terminal positions plus additional abutments regardless of force factors or bone density. The other guidelines to the key implant positions determine the most important additional sites for the implant placement.

Abutment Types

One-Piece Implant System

In this type, the implant and the abutment are formed as a single solid unit. In this case, there is no screw-joint between the implant and the abutment.

The lack of a screw-joint is considered an advantage as there is no screw-loosening, dangerous fracturing or micro-motions between the abutment and the implant. The one-piece implants may be used when narrow implants are indicated, such as in the replacement of the maxillary lateral incisors and lower incisors, or when bone volume is limited and the use of standard implants is not suitable. These types of implants are installed only with the one-stage implant placement method. Examples of a one-piece implant are the one-piece conical titanium implant and Y-TZP Ceramic Implant.



Two-piece implant system

The two-piece implant type consists of an implant to which an abutment or a restoration/attachment is connected, usually with a screw. It is more commonly used than the one-piece implant type. With this implant type, both the one- and the two-stage implant surgery protocol can be implemented.

Abutment implant interface:

The implant / abutment interface connection, is generally described as an internal or external connection. The distinctive factor that separates the two groups is the presence or absence of a geometric feature that extends above the coronal surface of the implant.

External connection

Historically, the first implants were designed with a flat butt-joint interface and an external hexagon to allow for the recording of the implant location, and to avoid rotation for single-unit restorations.

This very well-documented connection allows some micromotion of the interface, and less rigidity during occlusal load transmission.

The connection can be further characterized as a slip fit joint, where a slight space exists between the mating parts and the connection is passive or, as a friction fit joint, where no space exists between the mating components and the parts are literally forced together.

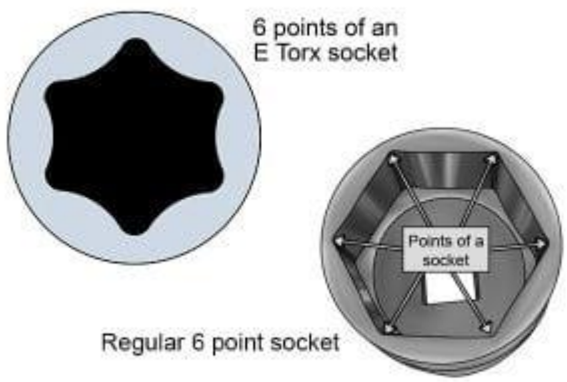
The joined surfaces may also incorporate a rotational resistance and indexing feature and / or lateral stabilizing geometry. This geometry is further described as octagonal, hexagonal, cone screw, cone hex, cylinder hex, 13 spline, cam, cam tube and pin / slot.

The internal connection implants can be divided into the following groups:

1. Passive fit/slip fit joint (space exists between mating components):

1) 6-Point Internal Hexagon Design

This is the most common type of internal implant-abutment connection. It has a sixsided geometric figure, that is, a hexagon recessed into the body of the implant. As the internal geometry is a hexagon, the abutment can fit over the implant at every 60-degree rotation of the implant over the abutment, but not at any other intermediate angle. Thus, abutment positioning is possible at six different positions of the implant over the abutment.

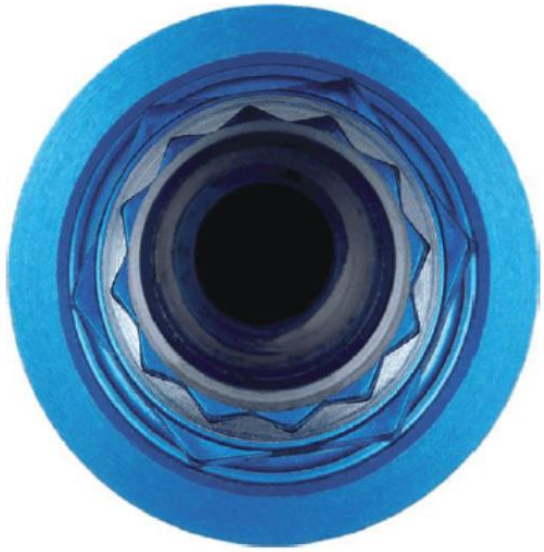


2) 12-Point Internal Hexagon

The 12-point internal hexagon design, is the offset hexagon design that allows for greatest freedom of placement of the abutment over the implant.

The 12-point double internal hex provides an opportunity to place the abutment on the implant for every 30-degree rotation, thus useful when we use angled abutments. It provides us with a greater opportunity to correct the off-axis angulation of the abutment with respect to the implant.

Though the 12-point internal hexagon design offers greater flexibility in the positioning of the abutment over the implant, the design should not compromise the mechanical properties of the implant–abutment interface.



3) 3-Point Internal Tripod

This type of implant to abutment connection represents a triangular internal geometry. A major disadvantage of this system is that it allows for positioning of the abutment over the implant at only 120 degrees of rotation.

It represents the Tri channel implant system. It is available in four diameters: 3.5, 4.3, 5 and 6 mm and is color-coded for ease of identification. As the replace select 3point internal tripod system offers limited options for positioning of the implant over the abutment, it is not a very clinically preferred design.

4) Internal Octagon Implant

The internal octagonal implant represents an 8-sided internal geometry connecting the implant and the abutment allowing for positioning of the implant over the abutment at every 45-degree rotation.

2. Friction Fit (no space between mating components) Locking taper/morse taper: The concept of morse taper implant-abutment connection design includes a tapered projection from the implant abutment, which fits into a tapered recess in the implant. There is a friction fit and cold welding at the implant–abutment interface. This implant-abutment connection depends on this friction fit for elimination for rotation at the implant-abutment interface and subsequent abutment screw loosening.

1) 8-Degree Morse Taper Implants

In dentistry, the concept of this morse taper or cone screw tapered connection was rationale in that a tapered connection would yield a mechanically stable, sound and self-locking interface. It basically creates a friction lock similar to the morse taper used in mechanical engineering and related industries.

2) 11.5-Degree Morse Taper Implant

In this implant the fixture and abutment are strongly connected at an 11.5-degree angle by the conical seal design. The conical design seals off the connection and decreases micromovement and microleakage. This thread has a micro-threaded conical neck and TiO blast surface. Microthreads on the fixture top prevent concentration of the stress around the alveolar ridge crest and decrease marginal bone loss.

3) 1.5-Degree Morse Taper Implants

This is a true morse taper implant with an angle of taper: 1.5 degree is available from Bicon implants. The Bicon locking taper abutment has no screw, but like a screw-retained abutment, it relies on friction to keep it intact.

Assembly is achieved by driving the 1.5-degree morse taper into the matching socket in the implant. A high clamping force between abutment and implant is generated by this action.

Prosthetic Attachments

A prosthetic or “superstructure” is retained to the abutment by:

(1) An abutment for **screw retention** uses a screw to retain the prosthesis or superstructure.

(2) An abutment for **cement retention** uses dental cement to retain the prosthesis or superstructure.

(3) An abutment for attachment uses an **attachment device** to retain a removable prosthesis

Each of the three abutment types may be further classified as straight or angled abutments, describing the axial relationship between the implant body and the abutment.

Screw-retained versus cemented fixed implant prostheses

Both types of prosthesis retention can give excellent long-term results, although the retrievability afforded by screw-retained prostheses clearly offers the safer and most versatile option.

Nonetheless some dentists prefer the cementation protocol since this approach precludes visibility of access openings in the occlusal or facial surfaces of the artificial teeth. It should however be emphasized that any sub-mucosal extension of a prosthesis could predispose to an iatrogenic peri-implant inflammation with attendant marginal bone loss if all cement remnants are not removed.

For full-arch prostheses a screw-retained design is recommended as any maintenance procedure or subsequent treatment can be performed more efficiently by removing the prosthesis; for example, in the case of technical problems such as fracture of the veneering material or of abutment screws or treatment of mucositis and peri-implantitis. The problem of screw access openings being located in aesthetically relevant areas can be solved by using angulated abutments (i.e. Multiunit abutments) or angulated screws channels.

Impression Techniques in Implantology

Impression Techniques

1- Implant level impressions

- ❖ Transfer type (close tray).
- ❖ Pick up (open tray).

2- Abutment level impressions

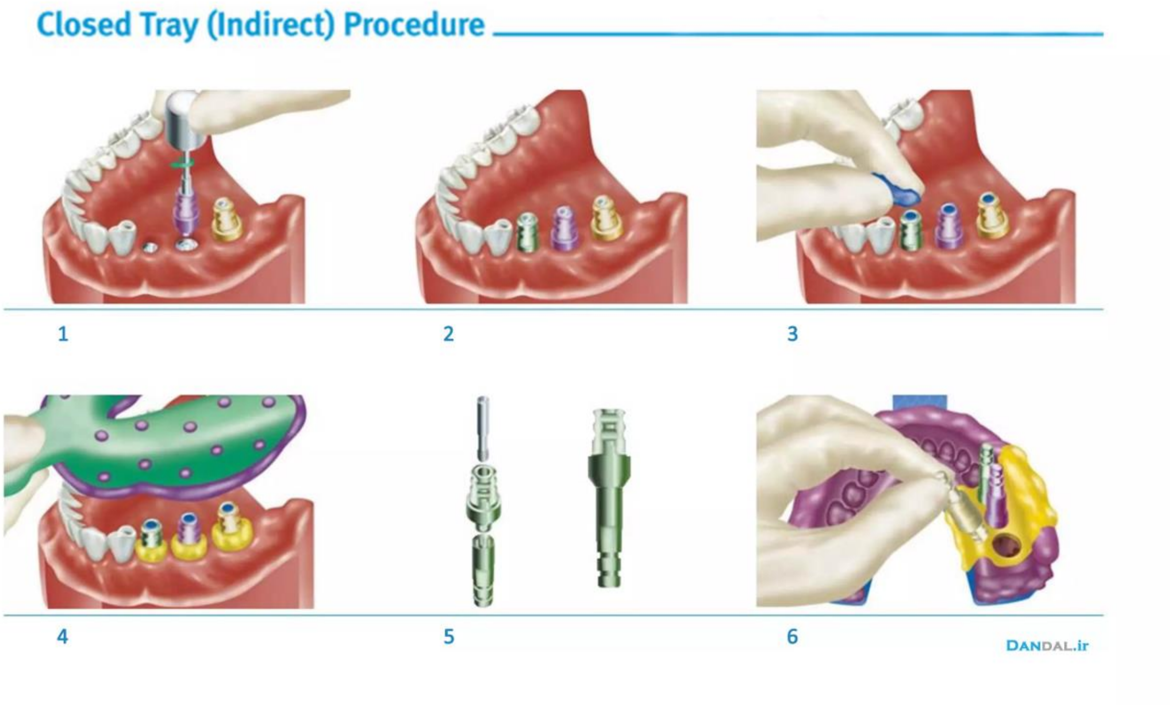
- ❖ Direct Techniques.
- ❖ Indirect Techniques.

Implant level impressions

Traditionally, there are 2 different implant impression techniques for transferring the impression copings from the implant to the impression.

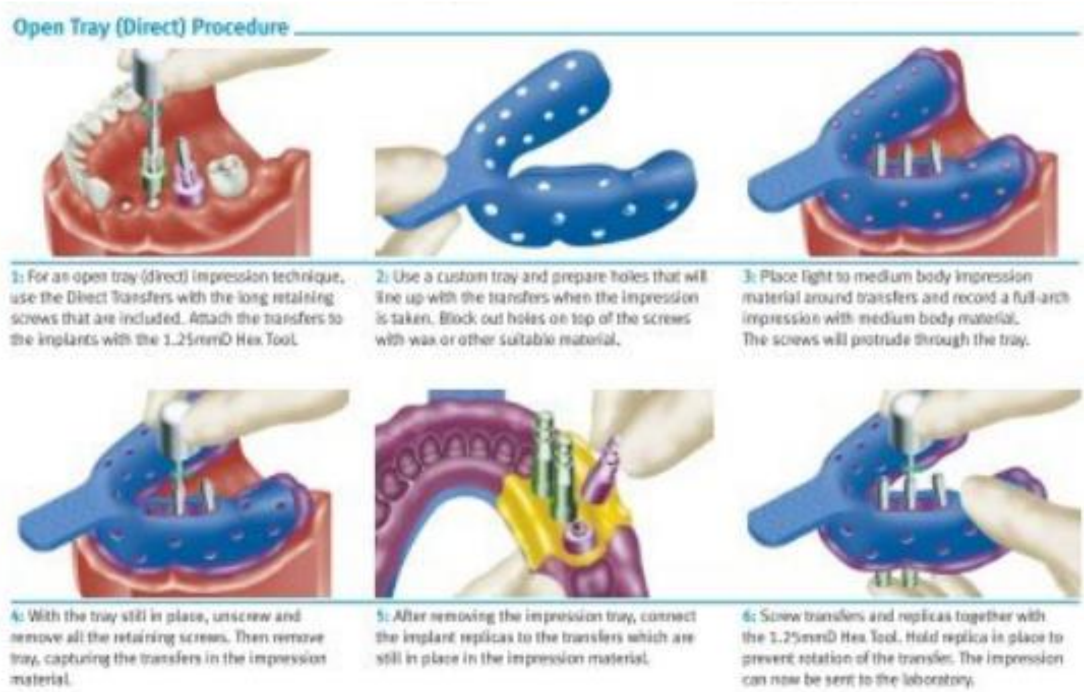
Transfer (closed tray) Technique

The transfer technique uses tapered copings and a closed tray to make an impression. The copings are connected to the implants, and an impression is made and removed from the mouth, leaving the copings intraorally. Subsequently the copings are removed and connected to the implant analogs, and then the coping-analog assemblies are inserted in the impression before pouring the definitive cast. **The clinical situations which indicate the use of the closed tray technique are:** when the patient has limited interarch space, tendency to gag, or if it is too difficult to access an implant in the posterior region of the mouth.



Pick-Up (Opened tray) Technique

Conversely, the pick-up impression uses square copings and an open tray (a tray with an opening), allowing the coronal ends of the impression coping screw to be exposed. Before separating the implants, the copings screws are unscrewed to be removed along with the impression. The implant analogs in the impression are connected to the copings to fabricate the definitive cast. Pick-Up Technique takes advantage of impression materials having rigid properties and eliminate the error of permanent deformation of impression materials because the transfer coping remains within the impression until the master model is poured and separated.



Advantages:

❖ Reduce the effect of implant angulation.

❖ Reduce the deformation of the impression material.

Disadvantages:

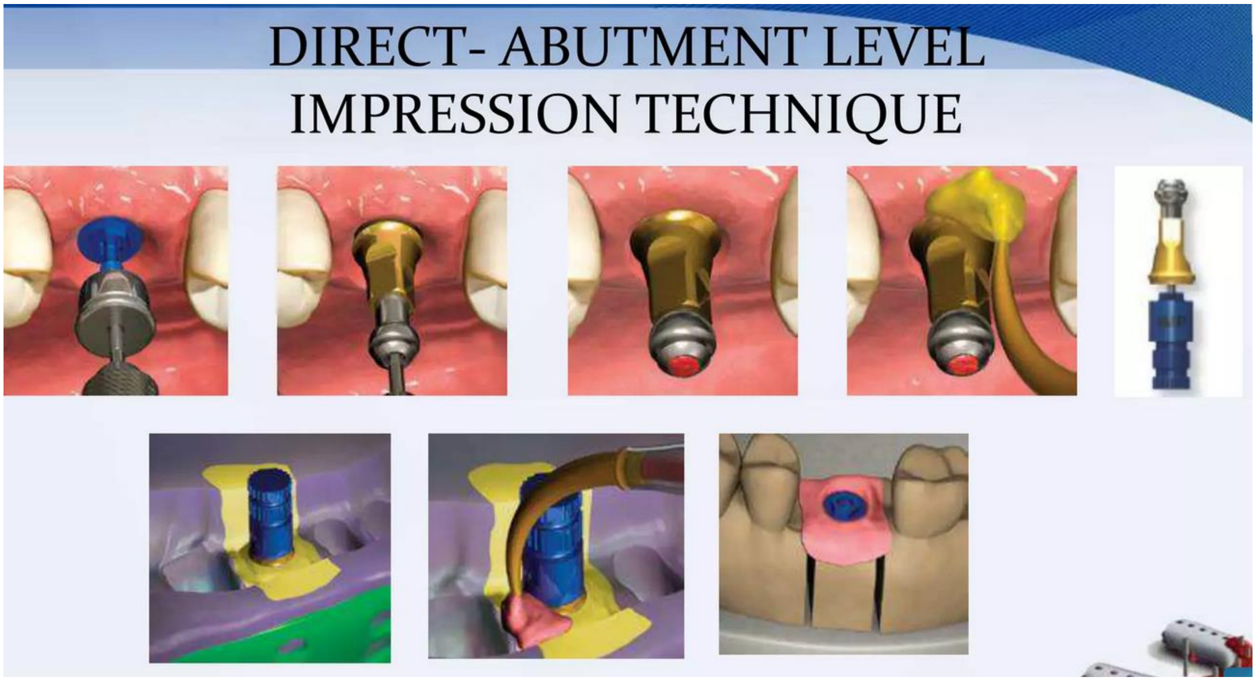
There may be some rotational movement of the impression transfer when securing the implant analog.

Abutment level impression.

1. Direct Techniques Option

The implant abutment may be restored as a natural tooth restoration. The abutment (usually prefabricated) is inserted into the implant body (usually screw retained rather than cemented as with a post in an endodontic-treated tooth).

After preparation of the abutment in the mouth, an impression is made of the abutment. A stone cast is poured, and an individual die of the abutment is trimmed. The restoration is fabricated very similar to a tooth. This prosthetic approach may be called a direct prosthetic option.



Advantages:

(1) familiar to restoring dentists.

(2) no laboratory analog components are required.

(3) splinting crowns together is less complicated, because manufacturer precision for analogs is not required and transfer of components is not required.

(4) reduced cost because analogs and laboratory fees for abutments are eliminated.

Disadvantages:

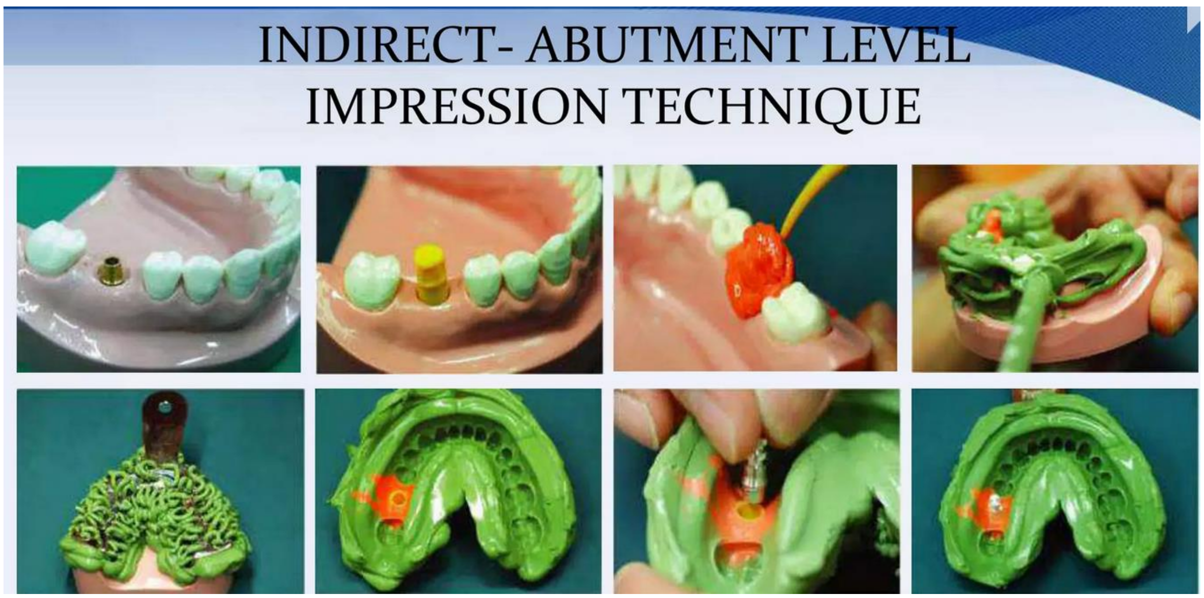
(1) the abutments are prepared in the mouth.

(2) retraction cord placement is required in esthetic zones or when additional abutment height is required for prosthesis retention.

(3) a different transitional restoration is often fabricated than the option during implant body healing because the abutment is inserted.

2. Indirect technique Option

The indirect technique **uses a closed tray to make an impression**. The clinical situations which indicate the use of the closed tray technique are when the patient has limited interarch space, tendency to gag, or if it is too difficult to access an implant in the posterior region of the mouth. An indirect- uses an impression material requiring elastic properties. The abutment is screwed into the implant body and remains in place when a traditional "closed-tray" impression is set and removed from the mouth. The abutment is removed from the implant body in the mouth, connected to an implant body analog, and then reinserted into the closed-tray impression before pouring the definitive cast; hence, the transfer is "indirect."



Occlusal Considerations in Implantology **Occlusion:**

1: The act or process of closure or of being closed or shut off.

2: The static relationship between the incising or masticating surfaces of the maxillary or mandibular teeth or tooth analogues.

Balanced articulation:

The bilateral, simultaneous, anterior and posterior occlusal contact of teeth in centric and eccentric positions.

Lingualized occlusion:

This form of denture occlusion articulates the maxillary lingual cusps with the mandibular occlusal surfaces in centric working and nonworking mandibular positions.

Mutually protected articulation:

An occlusal scheme in which the posterior teeth prevent excessive contact of the anterior teeth in maximum intercuspation, and the anterior teeth disengage the posterior teeth in all mandibular excursive movements.

Group function occlusion:

An occlusal scheme in which lateral pressure are distributed to all working side teeth in contrast Mutually Protected Occlusion where lateral pressure is directed only to the working side canine.

Significance of Occlusion on Osseointegrated Implants

- There are **no** specific **defence mechanisms** against occlusal forces in implants:

  poorly restored occlusion ➡ deleterious effect.

- **Prosthesis must** be fabricated as **accurately as possible** in order to achieve long standing success and occlusion should be key factor in overall success rate.
- An **impact force** can have destructive effects on prosthesis and implants and supporting bone.
- Teeth should contact simultaneously when mandible closes into maximum intercuspal position.

Occlusal Goals for Implant Prosthodontics:

- Bilateral simultaneous contact.
- No prematurities in retruded contact position. (RCP)
- Smooth, even, lateral, excursive movement with no nonworking interferences.
- Equal distribution of occlusal forces.
- Freedom from deflective contacts in intercuspal position (IP).
- Anterior guidance whenever possible

Implant Protective Occlusion (IPO)

IPO was previously known as medial positioned-lingualized occlusion. This occlusal concept refers to an occlusal plane that is often unique and specifically designed for the restoration of endosteal implant.

A primary goal of IPO is to maintain the occlusal load that has to be transferred to the implant body within the physiologic limits of each patient.

IPO addresses several conditions to decrease stress to implant interface

- No premature occlusal contacts or interferences.
- Influence of surface area.
- Mutually protected articulation.
- Cusp angle of crowns (cusps inclination).
- Occlusal contact positions.
- Implant crown contour.

No premature occlusal contacts or interferences:

The implant has no periodontal membrane, concerns centre around the potential for the “nonmobile” implant to bear the total load of the prosthesis when joined to the “mobile” natural tooth.

Four important components may contribute movement to the system: implant, bone, tooth, and prosthesis.

The initial difference in vertical movement of teeth and implants in the same arch 28μ.

Initial occlusal contacts should account for this difference or implants will sustain greater loads.

Occlusal prematurities are ideally eliminated on teeth before implant reconstruction. Thin articulating paper (less than 25μ thickness) is then used for the initial implant occlusal adjustment in centric relation occlusion under a light tapping force.

The implant prosthesis should barely contact, and the adjacent teeth should exhibit greater initial contacts. Only axial occlusal contacts should be present on the implant crown.

Once the equilibration with a light bite force is completed, a heavier centric occlusal force is applied.

The contacts should remain axial over the implant body and may be of similar intensity on the implant crown and the adjacent teeth under greater bite force to allow all elements to react similar to the occlusal load.

Hence to harmonize the occlusal forces between implants and teeth, a heavy bite force occlusal adjustment is used because it depresses the natural teeth, positioning them closer to the depressed implant position and equally sharing the load. The initial lateral movement of healthy anterior teeth ranges from 68 to 108 μ before secondary tooth movement.

Anterior implant movements are not immediate and range from 10 to 50 μ. Because of the greater discrepancies in lateral movement, the occlusal adjustment in this direction is more critical to implant success and survival.

A similar scenario is used for the occlusal equilibration - implants joined to natural teeth. A light force and thin articulating paper are used, and the implant crown exhibits minimum contact compared with the natural abutment crown.

A heavy bite force is then used to establish equal occlusal contacts for all abutments and the entire prosthesis, whether implant or natural.

Influence of surface area:

An important part of IPO is the adequate surface area to sustain load transmission to the prosthesis.

Wider diameter root form implants have a greater area of contact at the crest than narrow implants which reduces the mechanical stress at the crest.

When narrow diameter implants are used in regions that receive greater loads, additional splinted implants are indicated to compensate for the design.

Placement of implants in posterior jaws to be staggered to improve biomechanical loads.

Crown cusp angle:

Occlusal contact along an angled cusp result in an angled load to the crestal bone.

Post implant crown should have wider central fossa perpendicular to implant body.

Opposing cusp should be modified to occlude in fossa.

Occlusal contact positions:

- Determines the direction of force.
- The marginal ridge contact is also a cantilever load because the implant is not under the marginal ridge.
- The ideal implant body position is usually under the central fossa and maybe **1-2mm** to the facial aspect (when bone is abundant) to be under the buccal cusp of the mandible and to improve the aesthetic emergence of maxillary implant crowns.

- The ideal primary contact should reside within the diameter of an implant.
- Secondary occlusal contact should remain within 1 mm of the periphery of implant. Marginal ridge and buccal cusp contacts should be avoided.

Implant crown contour:

- A wide occlusal table favour offset contacts during mastication or parafunction. Narrower implant bodies are even more vulnerable to occlusal table width and offset loads.
- Wider root form implants can accept a broader range of vertical occlusal contacts while still transmitting lesser forces at the permucosal site under offset loads. Therefore, in IPO the width of the occlusal table is directly related to the width of the implant body.
- Restorations mimicking the occlusal anatomy of natural teeth often result in offset loads (increased stress), complicated home care and increased risk of porcelain fracture.
- In nonaesthetic regions of the mouth, the occlusal table should be reduced in width compared with natural teeth.

Prosthodontics

Lec.23 **Dr. Safwan A. Suliman**

Dental implant materials

Dental implants: a prosthetic device made of alloplastic material(s) implanted into the oral tissues beneath the mucosal and/or periosteal layer and on or within the bone to provide retention and support for a fixed or removable dental prosthesis; a substance that is placed into and/or on the jaw bone to support a fixed or removable dental prosthesis

The composition and nature of the surface on an implant are important characteristics because of their effect on the biologic development of an interfacial relationship between the bone and the implant.

To be successful, an implant must meet four conditions:

1. **Biocompatible** so there is no undesirable reaction between the tissues and the implant (i.e. corrosion, dissolution and/or resorption)
2. **Have an interface** that stabilizes postoperatively in as short a time as possible;
3. **Capable of carrying and transferring the occlusal stresses that are placed upon it**; and
4. **Remain stable** for a long period of time.

A knowledge of the composition of implant materials, their surfaces, and their forms are important factors when developing an understanding of the biocompatibility of implants and how they develop a symbiotic relationship with living tissues.

Osseointegration:

1. The apparent direct attachment or connection of osseous tissue to an inert, alloplastic material without intervening fibrous connective tissue;
2. the process and resultant apparent direct connection of an exogenous material's surface and the host bone tissues, without intervening fibrous connective tissue present;
3. the interface between alloplastic materials and bone.

Biomaterials any substances other than a drug that can be used for any period of time as part of a system that treats, augments, or replaces any tissue, organ, or function of the body.

Biomaterials: A synthetic material used to make devices to replace part of a living system or to function in intimate contact with living tissue.

A variety of devices and materials are used in the treatment of disease or injury. Common place examples include suture needles, plates, teeth fillings, etc.

Bio-compatibility: Acceptance of an artificial implant by the surrounding tissues and by the body as a whole.

Selection of Biomedical Materials

The process of material selection should ideally be for a logical sequence involving:

1. Analysis of the problem;
2. Consideration of requirement;
3. Consideration of available material and their properties leading to:
4. Choice of material.

The most common classes of materials used as biomedical materials are **polymers**, **metals**, and **ceramics**. These three classes are used singly and in combination to form most of the implantation devices available today.

Implant material should have suitable mechanical strength, biocompatibility, and structural biostability in physiologic environments. The development of biomaterials sciences has resulted in classification schemes for implantable materials according to chemical composition and biologic response.

Classification of implant materials:

1. **According to biocompatibility of the material in the bone** Strunt's classification.
2. **According to type of materials.** metallic or non-metallic (Combe's classification).

1. **Strunt's classification according to biocompatibility:**

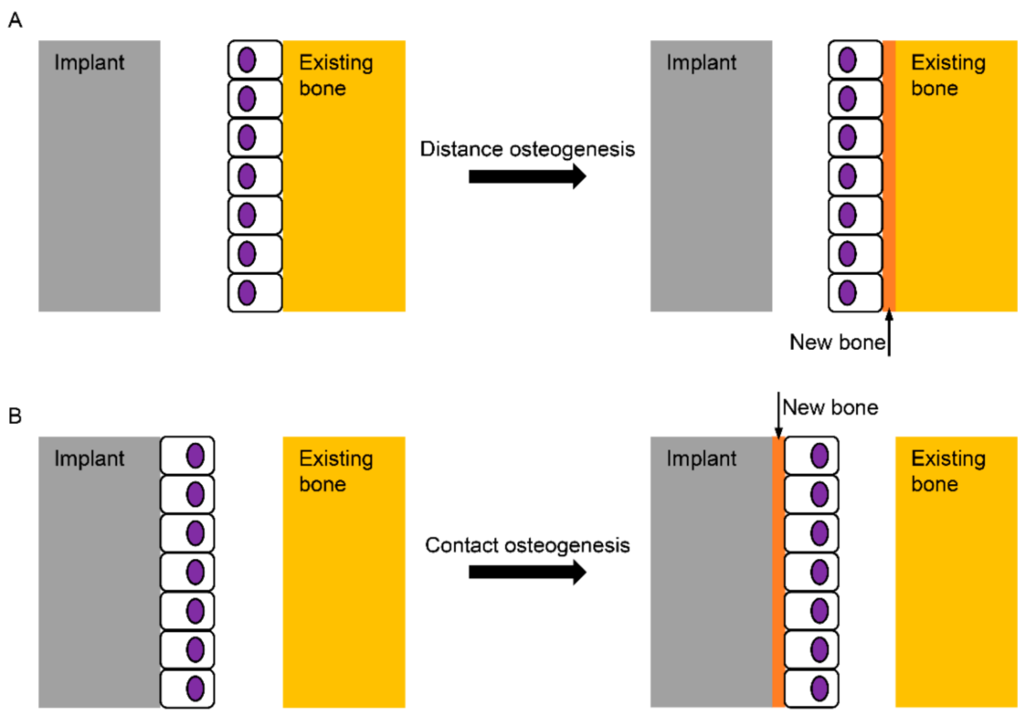
   Depending on their reaction with surrounding bone and on the ability of implant material to stimulate bone formation (**behavior of the material in bone**)

a. **Distant osteogenesis:** (Bio tolerated material):

   In this type, there will be a **gap** between implant & bone which is **filled with connective tissue**. There will be a connective tissue capsule (fibrous scar). Possible osteoid or chondroid contact can be seen. The type of the materials includes, Stainless steel, Co-Cr-alloy, gold alloy, poly methyl methacrylate.

b. **Contact osteogenesis:** (Bio inert material):

   In this type, there is contact between implant & bone like: Titanium. Tantalum, Aluminum oxide & ceramic (non-reactive type).



Ceramics are 2 types:

- **Reactive:** induce bone formation
- **Non-reactive:** does not induce bone formation

c. **True bond osteogenesis:** (Bioactive material)

In this type, there is a **chemical bond** between the implant and bone, materials like ceramics bio-glass, calcium phosphate apatite.

d. **Bond osteogenesis:** (Bio inert & structure osteotropic material)

In this type there is **physical** & **chemical bonding** of implant to bone, materials: Titanium with rough surface (to increase the surface area) & very thin thickness of coating layer.

2. **Combe's classification:**

1. **Non-metallic material**.
2. **Metallic material.**

1. Non-metallic materials:

a. **Bio inert (non-reactive):** mean minimal interaction between implant material & the tissue like: **Polymers**, **Vitreous carbon**, **nonreactive types of Ceramic** e.g. (Aluminum oxide and Zirconium oxide).

Polymers: There are a large number of polymeric materials that have been used as implants or part of implant systems. The polymeric systems include **acrylics**, **polyamides**, **polyesters**, **polyethylene**, **polysiloxanes**, **polyurethane**, **polytetra-fluoro-ethylene** (PTFE), **poly ether ether ketone** (PEEK) and a number of reprocessed biological materials.

All polymers are **radiolucent**, they are used as coating or membrane but nowadays they used the PEEK as solid implant after modification of their mechanical properties by addition of different types of fillers.

Vitreous carbon: Stable & well tolerated material, classified as ceramic because of inertness & biocompatibility. It has undesirable physical properties, widely used in cardio vascular disease.

Disadvantages of carbon:

1. It has not performed well in clinical practice & high percentage of clinical failure & withdrawal of this device.
2. Radiolucent in x-ray.
3. Color of the material is black.
4. Brittle & lack of ductility.

The pyrolytic carbons appear to have better potential due to their enhanced physical properties & may be further reinforced with carbon fiber producing a material which is well tolerated when implanted.

Non-reactive ceramics:

- One type of non-reactive ceramics that has shown evidence of success in clinical studies is made from Aluminum oxide (Al_2O_3), either as a poly crystalline or as single crystal
- Although this ceramic is well tolerated by bone, it is not bioactive, because it does not promote the formation of bone

- It does possess high strength, stiffness and hardness
- These implants are designed with either screw or blade shape
- It appears to work optimally when they are used as abutment for prosthesis in partially edentulous patient.

Zirconia-based ceramics

- It is well tolerated in the tissue
- Possess mechanical stability during the experimental method of one year
- Attractive color
- Ease of preparation of abutment
- Radiographic opacity
- Surface structure is important to create enough unique fracture toughness
- Because of their good combination of mechanical property and excellent biocompatibility, Zirconium's ceramics are recognized as one of the best biocompatibilities for joint prosthesis.
- Proper quality control during manufacturing & polishing when used as endosseous dental implant.

b. Bio active (Hydroxy apatite, Bioglass):

those material used to enhance the bond strength of implant to bone & accelerate the rate at which attachments occurs mainly used as coating applied to develop bounded interface with bone to promote bone formation.

The bioactive materials promote bonding to bone by:

1. Providing bonding sites for collagen fibers.
2. Providing an environment which favors osteoblast over fibroblast.
3. Releasing ions which promote hydroxyapatite formation.

- ➢ have a bone-implant interface characterized by direct chemical bonding of the implant with surrounding bone.

- Free calcium and phosphate compounds at the surface.
- Are materials which have designed into them a controlled surface reactivity.

Surface reactivity effect on ionic changes and this effect osteoblast formation rather than osteoclast formation, but this depends on the field. Used as coating not as implant because of brittleness and dissolution of the material.

Hydroxy apatite

HA ceramics has been shown to be biocompatible. non-toxic & capable of forming a biochemical bond with bone due to its chemical similarity to bone mineral. The use of HA as coating for titanium substructures addressed to mechanical deficiencies of the material while realizing the benefits of its bioactivity.

Bioglass:

- Dense ceramic material made from CaO, Na_2O, PO_5, Si_2O, this material bonds chemically to bone. The bond has been shown to be strong that when tested failure fracture occurs with bone or bioglass material leaving interface intact.
- Thus, the brittle nature of bioglass become the limiting factor in its use as stress bearing dental implant.

2. Metallic materials:

The conventional metals and alloys used for medical devices belong to **three main metallic systems**: **stainless steel**, **cobalt chrommium alloys** and **titanium alloys.**

These systems exhibit an excellent combination of high strength, relative workability and good resistance to corrosion. The improvements made mainly consist in **variations in the chemical composition**, **heat treatments** and

processing technologies in order to improve aspects such as fatigue behaviour, wear, corrosion, ion release and stress transmission to the surrounding tissues.

- Metal like Stainless steel & Co-Cr alloy because of their acceptable physical properties and relatively good corrosion resistance.
- They are tolerated by bone to a certain extent but cannot integrate with it.
- So currently titanium or titanium alloy implants are widely used for their superior properties of biocompatibility
- Other metals that are used as implants materials are gold, tantalum.

Titanium

- They have proven their worth as a material of choice for the prosthetic superstructure since the late 80"x. titanium has certain specific properties which makes it absolutely ideal for these applications.
- It is a silvery-gray metal of groups IV b of the periodic table. It is light weight metal with density of 4.51 g/cm^3, it has low elastic modulus of 110 GPa and a relatively high melting point of 1668°C.
- Pure titanium is **ductile**, **elastic modulus is 1/2 of steel** & **5 times greater than compact bone**.
- Titanium is a reactive metal. This mean that in air, water or any other electrolyte **an oxide is spontaneously** formed on the surface of the metal. This oxide is one of the **most resistant minerals** known, building a dense film which protects the metal from chemical attack, including that of aggressive body fluids.
- Titanium is (inert) in tissue. The **oxide film in contact** with the tissue as practically **insoluble**; **no ions are released** that could go on to reach with organic molecules.

- Titanium possesses **good mechanical properties**. Its tensile strength is very close to that of the stainless steel used for load-bearing surgical implant.
- The **poisoning effect of titanium is low** because the metal is passivated by the immediate formation of the surface oxide during manufacturing. The thickness of the oxide increases during sterilization in water vapor. It is this oxide layer that the biomolecules meets when the implant is placed into bone. Beside its excellent physical properties. **Ti** has a **high corrosion resistance.**

Commercially pure titanium CPT

- CPT is available in **four grades**, the **purest** is known as **grade 1**

American specification require that such material should contain maximum of **0.18%** by weight of **oxygen** and **0.2%** by weight of **iron**. The strength of CPT **increases with increase concentration of oxygen & iron**.

Grade 1: titanium is the **softest**. The **most ductile**, made as barrier for GBR (Guided Bone Regeneration) procedure.

Grade 2: Used for **Implant** and **abutment parts**.

Grade 4: is the **hardest type & least ductile**.

Ti- 6 Al- 4V: 90% Titanium, 6% Aluminum, 4% Vanadium, 0.25% (max) iron and 0.2% (max) oxygen. Require particular tensile strength of these alloy.

- (Ti-6AI-4V) alloy was found to cause adverse tissue reaction in the interface in contrast to CPT, the metal has been found to **cause the most natural tissue reaction of those metals tested**.

Types of surface modification:

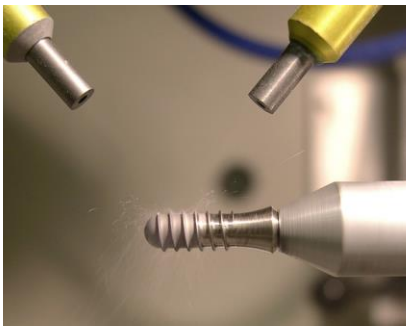
1. Machined surfaces:

The microscopic surfaces of machined implants are related to machining operation used for forming the threated shapes & include fine machining lines, pits & grooves. Such features invariably occur during machining of metal such as Ti & Ti alloys. These line surface features may be significant for promoting osteoblast adherence, bone formation & attachment to the implant surface & therefore promoting osseointegration.

Fig. 1. Screw-type Brånemark MK III implants.

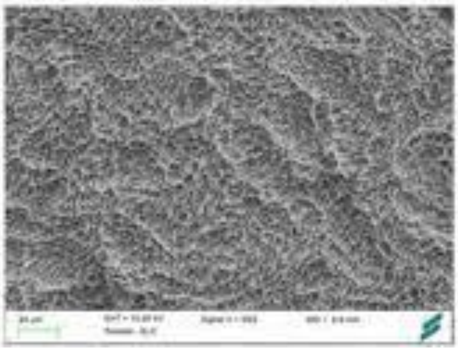
2. Shot-blasted features:

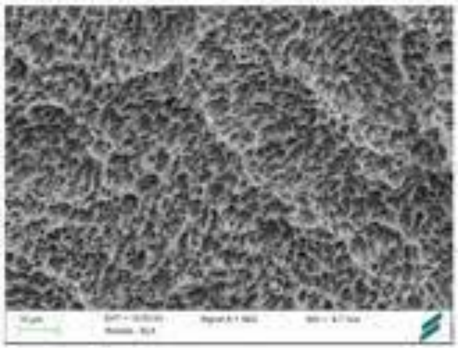
Using of sand blasting medium for producing rough surface. Typically. $A1_2O_5$, Sic, glass or TiO_2, shot (particles) is used to erode a substrate to form very irregular surface with pits, depressions that vary in size & shape depending on the blasting condition.

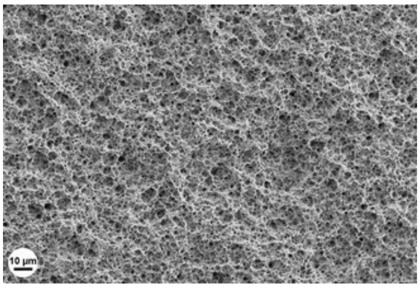


3. Chemically etched surface:

Chemical etching has been used to develop **textured bone-interfacing implant surfaces for enhanced implant fixation**. As a result of the controlled surface chemical attach that results from exposure to acid solutions small pits form more or less regular arrays over the implant surface. The result of such treatment is significant increase in implant surface area (2 time or more) that result in more effective mechanical interlock of bone & improved implant fixation.





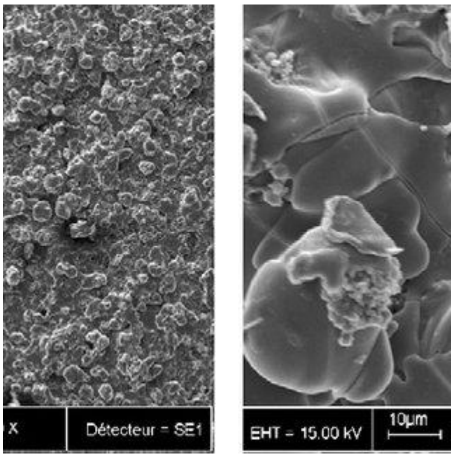


4. **Porous Sintered Surfaces:**

This is another approach for achieving fixation by bone in growth & micro mechanical interlock through sintering Ti-6AI-4V alloy powders to a mechanical Ti alloy substrate.

5. **Plasma-sprayed surfaces:**

process by which a material is **deposition onto** a substrate to form an irregular surface suitable for promoting secure implant fixation by bone growth onto surface irregularities. It is used widely because of the higher temperature reached & higher powder particle velocities. It exhibits higher densities & higher bond strengths.



Plasma is a neutral electrical flame containing equal amount of positive & negative charges. The ions & electrons are produced by passing a gas or mixture of gases through a high current arc.

Surface design: the design of implant surface can be:

- Porous
- Roughened (minimize shear movement)
- Granulated
- Textured (screw shaped surface is ideal for dental implant).
- Smooth (weak bonding because sliding of implant).

Ceramic coating:

The types of ceramic coatings available include both:

- the **bioactive type** such as **calcium phosphates** &
- the **inert ceramics** such as **aluminum oxide** & **zirconium oxide.**

Methods of applying ceramic material as coating for dental implant are:

1. Plasma spraying.
2. Vacuum deposition techniques.

3. Sol Gel & Dip coating method.
4. Electrolytic processing (Electrochemical).

Electrochemical coating has advantages:

1. Thin coating layer.
2. Fine crystalline structure.
3. High solubility.
4. 100% coverage of porous implant structure.

Advantage of HA coating:

1. Aids in direct bonding of bone to the implant surface.
2. Quick closure of the surgical site as a new bone grows from the implant surface to meet bone growing from the socket.

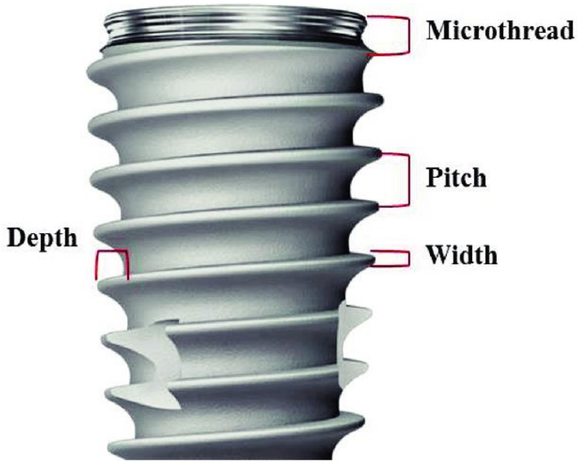
- The final properties of a ceramic coating are influenced by the method of processing.
- The most popular ceramic coating from a commercial stand point is plasma -sprayed HA.

Enhancement of bone -to-implant contact

Many methods used for these purposes:

1. **Hydroxyapatite** plasma sprayed onto a roughened & prepared titanium implant (HA coating range from 50-70nm), also pressurized hydrothermal post plasma – spray increase the crystalline HA content from 77 to 96% this improves bone adhesion.
2. **Titanium plasma-sprayed surface implant**. The process is characterized by high-velocity **molten drops of metal being sprayed onto the implant body** to a thickness of **10-40nm** this will get greater area for bone attachments & more term results in fully & partially edentulous patient.

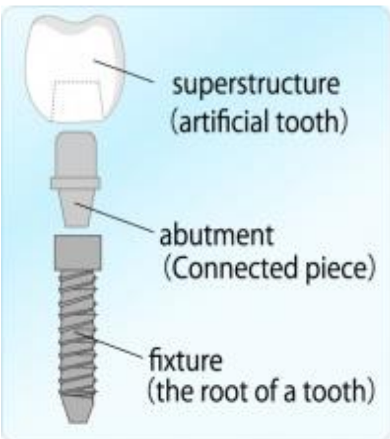
3. **Implant surface-Pitch**, the **number of threads per unit length**, is an important factor in implant osseointegration. Increased pitch and increased depth between individual threads allows for improved contact area between bone and implant.



Moderately rough surfaces with **1.5µm** also, improved contact area between bone and implant surfaces.

Super structure:

It could be defined as a metal framework that fits the implant abutments and provides retention for the prosthesis. Recently, it is defined as the superior part of multiple layer prosthesis that includes the replaced teeth and associated structures.



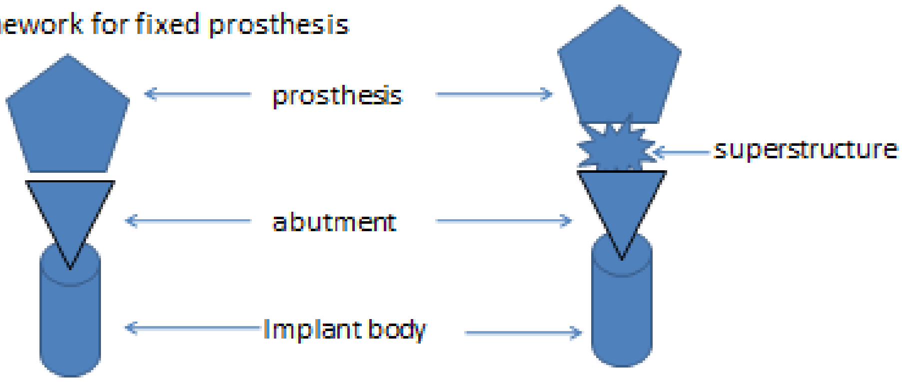
Prosthetic Attachment

Abutment

portion of the implant that supports or retains a prosthesis
or implant superstructure

Superstructure

metal framework that attaches to the implant abutment
and provides either retention for removable prosthesis
or framework for fixed prosthesis



Implant Protheses Restoration

Cement-Retained Multiple Unit castable with extension and stabilizing abutment.

GBR (Guided Bone Regeneration)

Bone augmentation procedures are frequently used in oral & maxillofacial reconstructive surgery when in sufficient bone volume for implant placement. Several methods including bone grafting & membrane techniques has been described.

Materials used as GBR:

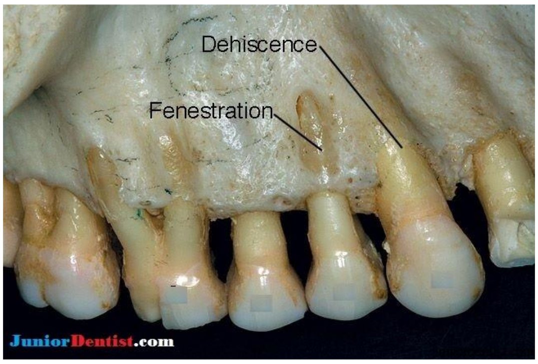
1. Millopore filter.
2. Poly lactic acid (PLA): it's used in iliac bone crest reconstruction.
3. Poly Galactine defect.
4. Collagene membrane.
5. Biobrane.

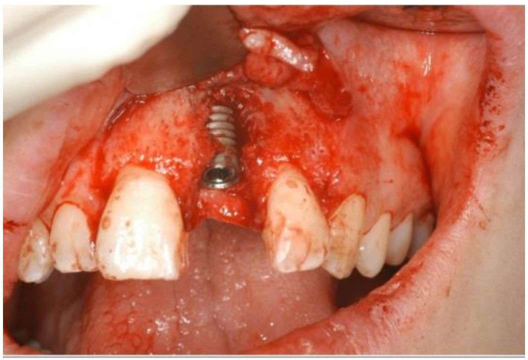
6. Dura matter.
7. Human periosteium.
8. e-PTFE (expanded poly tetra fluoro ethylene) most biocompatible material used in dental implant.

- The principle of (GBR) has been successfully applied to the regeneration of bone in conjunction with the placement of endosseous dental implants where insufficient bone support exists before or after placement of implants.
- e-PTFE membranes could regenerate bone in surgically created jaw defect, use a special membrane & under it special bone (pure tri-calcium phosphate) Ca:Po$_4$, which is bioresorbable material, it will induce bone formation & then it will resolve like scaffold, when we put the membrane the bone will be guided in one direction for 1 month.

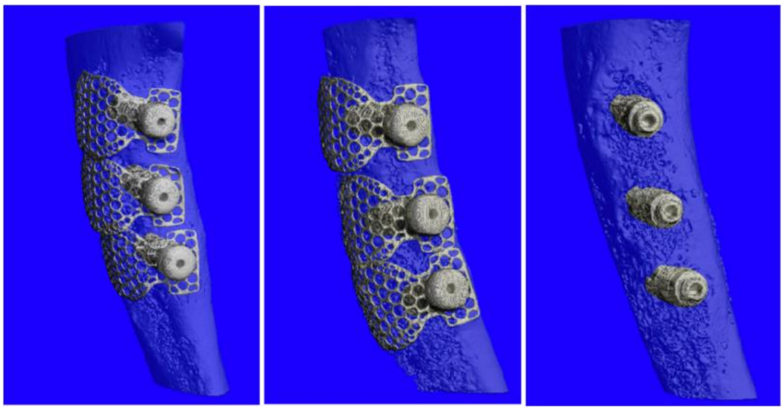
Indications

1. Dehiscence defects.

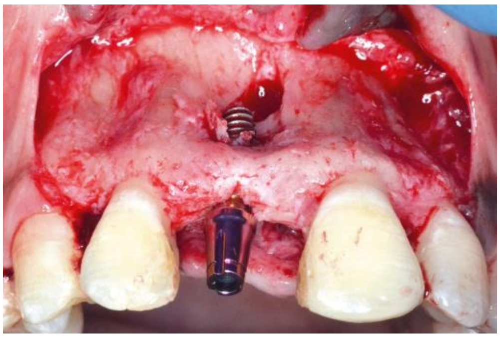




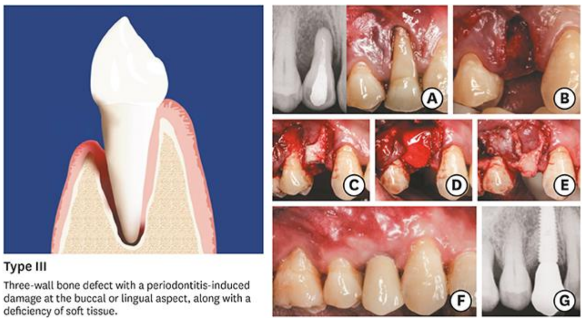
2. Residual osseous defect.

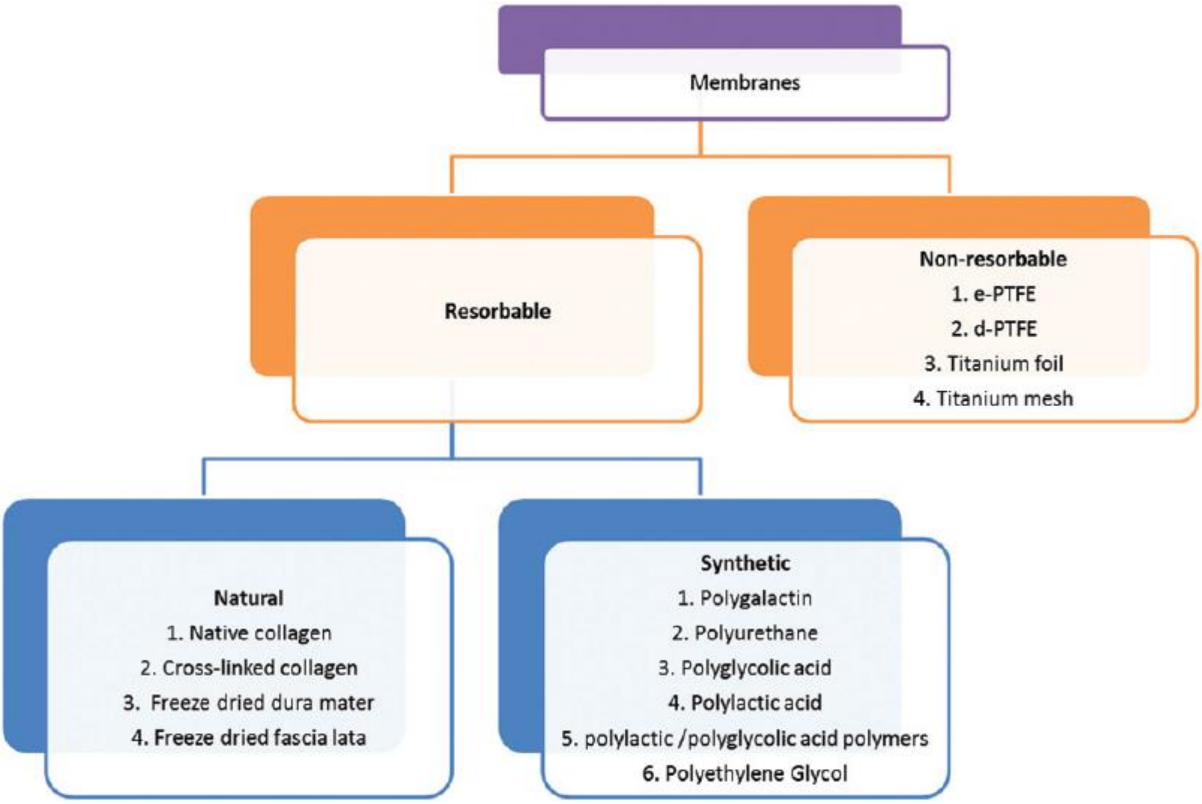


3. Fenestration defect.



4. Extraction defect





Non-resorbable membrane for oral surgery

TEFGEN-FD:

Table 1. Commercially Available Non-resorbable Synthetic Barrier Membranes.

Product (Company)	Material	Resorption Period
BoneShields® (FRIOS)	Titanium	Non-resorbable
Cytoflex® Tefguard (Unicare Biomedical)	PTFE	Non-resorbable
Cytoplast™ Ti- Reinforced (Osteogenics Biomedical)	Ti-PTFE	Non-resorbable
Gore-Tex® (Gore-Tex®)	e-PTFE	Non-resorbable
T-Barrier membrane (B&B Dental)	Titanium	Non-resorbable
TefGen-FD	PTFE	Non-resorbable
(Keystone Dental, Inc.)		
Ti-Micromesh (ACE)	Titanium	Non-resorbable
Tocksystem (MeshTM)	Titanium	Non-resorbable

- Totally inserted biomaterial
- optimal use in oral surgery
- Easy handling

Application in:

1. Protect extraction site.
2. Cover periodontal defect.
3. Provide space for bone augmentation.
4. Augment implant site.
5. Cover peri implant defect.

Advantages:

1. Non porous the pores are 0.2 micron.
2. No primary closure necessary.
3. Membrane can remain expose to oral cavity.
4. Healing without infection.
5. Handled easy.
6. Uncomplicated removal, no need for 2nd surgery described.

Mechanism of bone grafting Osteogenesis Osteoconduction Osteoinduction

Osteogenesis: is the development of bone; formation of bone, an osteogenic graft is derived form or composed of tissue involved the growth or repair bone

Osteogenic cells differentiate and the different phases of bone regeneration, encourage bone formation in soft tissue, or active quicker bone growth

Osteoinduction: the capability of chemicals or procedures to induce bone formation through the differentiation and recruitment of osteoblasts; phenotypic conversion of mesenchymal cells into osteoblasts.

Osteoinduction is the act or process of stimulating osteogenesis. It can be used to enhance bone regeneration, and bone may even grow or extend into an area where it is not normally found.

Osteoconduction: the process whereby bone grows on a surface or on a scaffolding that is conductive to bone deposition; this is a passive process. Osteoconduction provides a physical matrix or scaffolding suitable for deposition of new bone a conductive to bone growth allow bone apposition form existing bone, but they do not produce bone formation when placed in soft tissue.

Osteoconductive graft: a graft material that serves as a scaffold for new bone growth; this is a passive process.

Type of graft material:

1. Autogenous bone
2. Allografts
3. Alloplasts

1. **Autogenous Bone:** originating or derived from sources within the same individual; self-produced; self-generated; autologous

Autogenous graft: a graft taken from the patient's own body. Autogeneous Bone an organic autologous material utilizes osteogenesis,

osteoinduction, osteoconduction the best grafting material from intraoral, extraoral.

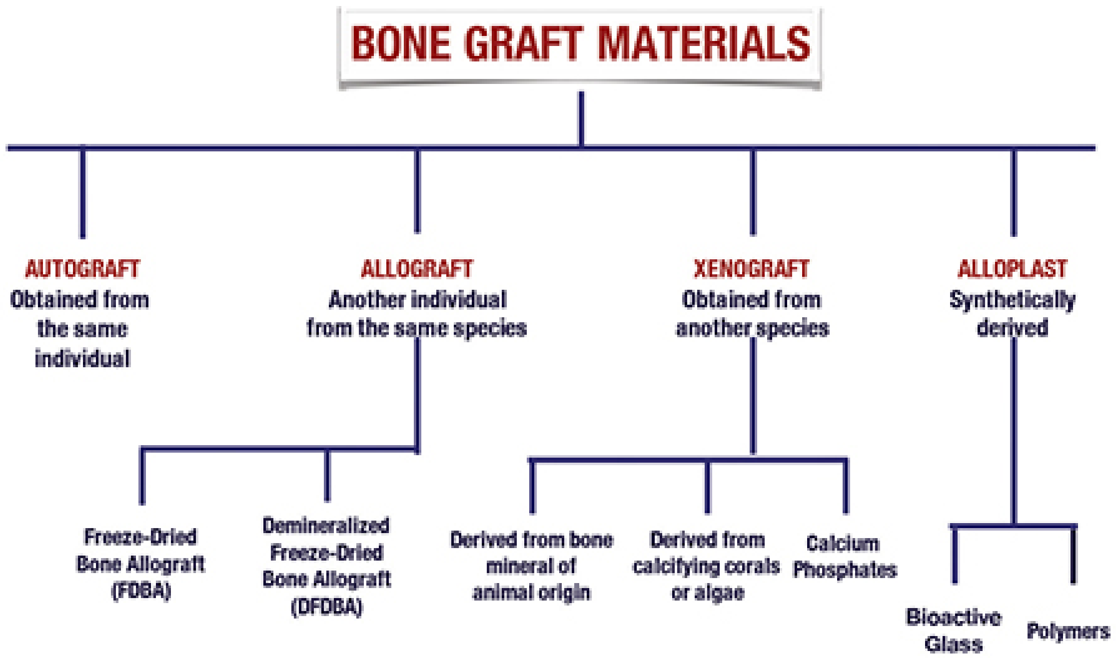
Disadvantage: Need for second operative site possibility of not being to obtain a sufficient amount of bone.

2. **Allografts:** a graft of tissue between genetically dissimilar members of the same species.
3. **Alloplast:**

1. an inert foreign body used for implantation within tissue;
2. a material originating from a nonliving source that surgically replaces missing tissue or augments that which remains

Alloplastic graft: a graft consisting of an inert material

alloplastic material: any non-biologic material suitable for implantation as an alloplast



Complete Denture Duplication

Lec.30 **د.صفوان عبد الحميد**

Definition

A duplicate denture is a second denture intended to be a copy of the first denture.

Synonyms

Copy dentures, Template dentures, Replica dentures.

Aims:

1. The transfer of contours from old to new dentures for maintenance of neuromuscular control.
2. Any modifications done to the basic shape of the old denture should therefore be only those necessary to correct the loss of fit i.e., (the patient's complaint) and those considered essential by the operator, e.g., a slight increase in the OVD and the replacement of the worn denture teeth.

Indications:

1. When it is desirable, especially for older patients, to provide replacement dentures (with improved fit) similar in most aspects to those to which patients are already accustomed. It is not easy for a geriatric patient to get used to a new denture with altered polished surface contours readily.
2. If we desire to renew old deteriorated and stained denture base material, the duplicate denture will have the appearance of being completely new.
3. If it is desired by a patient to have a spare denture in case of accidental fracture or loss of the original denture. The patients often are concerned about being without dentures during the required repair or relining process.
4. If we need to experiment with interchanging the occlusal relationship of the dentures – for clinical or research reasons. This could be carried out on the spare denture, without changing the original one.

When to Duplicate a Denture?

• We are not going to duplicate a denture unless its examination reveals satisfactory findings as regards to esthetic, physiologic, and psychologic needs of a patient.

• The denture(s) should be evaluated for any previous fractures, craze lines, missing or replaced teeth, esthetics, phonetics, the accuracy of fit, and vertical and centric relations.

• based on this examination, the patient is then advised whether the existing denture should be duplicated or remade.

Temporary Duplicate Dentures

Production of temporary duplicate dentures is sometimes carried out with the aim that these can be progressively modified if the patient's capacity to adapt is in doubt (e.g., gradual increase in the occlusal vertical dimension) or if the cause of the patient's complaints is not clear (e.g., the patient may be a denture collector). These could be fabricated at a low cost and with less clinical and laboratory time. Once a satisfactory appliance has been achieved, it can then be copied to produce a definitive denture.

Techniques for Denture Duplication

Several methods or techniques have been reported for producing a template for a duplicate or copy denture. All these techniques are similar except in the use of mold containers and materials. Some of these methods are:

• Modified denture flask method
• Duplicating flask method
• Pour resin flask method
• Cup flask method
• Soap container method
• Agar container method

A mold of the old denture is produced in an elastic material, such as alginate or silicon putty supported in a rigid container.

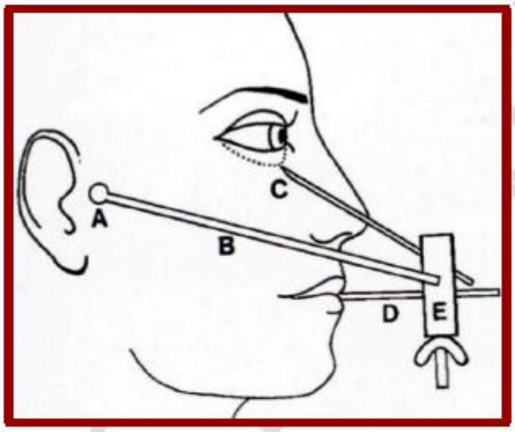
The wax or auto-polymerizing resin template is fabricated from this mold. Any necessary modifications to the old denture are performed on this template denture and tried – in the patient's mouth before finishing the prosthesis.

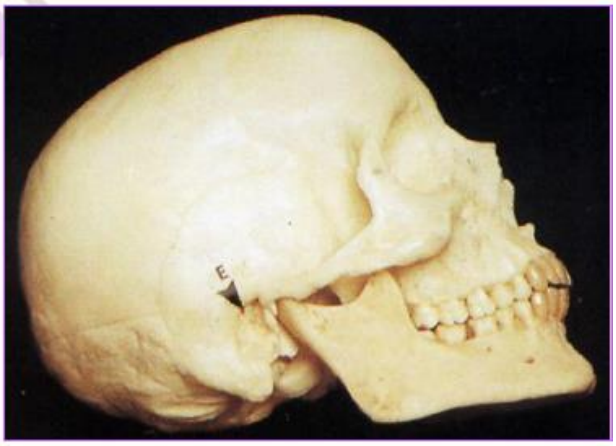
In some of the techniques, auto-polymerizing resin teeth are also fabricated instead of using an available ready-made mold, especially for temporary duplicate dentures.

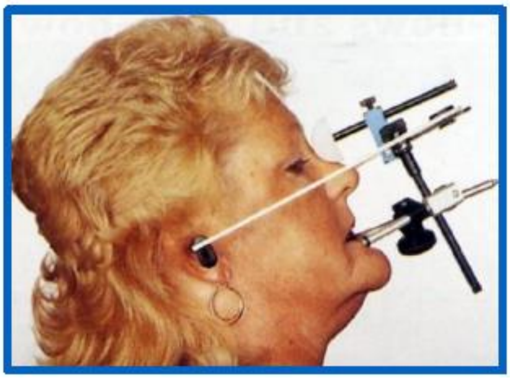
Denture Duplication Technique 'The Duplicating Flask'

1st visit

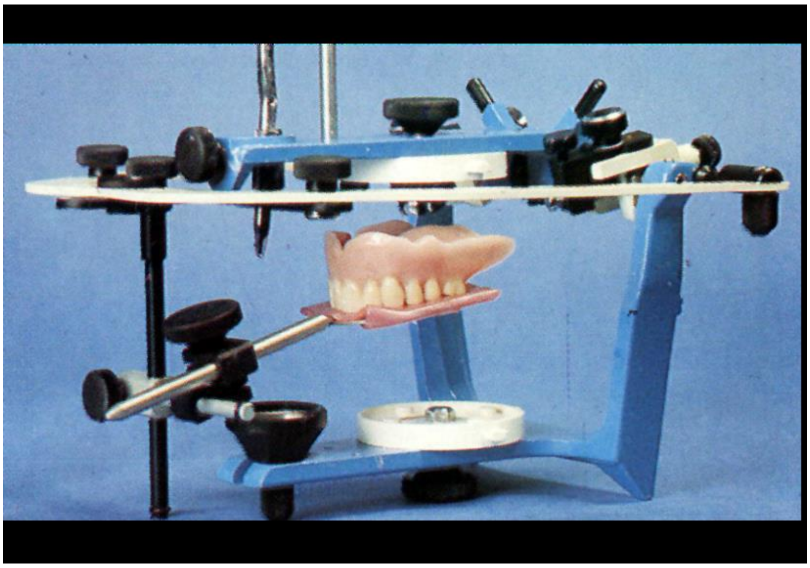
This visit includes duplication of the old denture in auto-polymerizing acrylic resin, recording the centric jaw relation, and selection of the shade, size, and form of the denture teeth if the previous selection (old denture) is not accepted by the dentist and the patient.



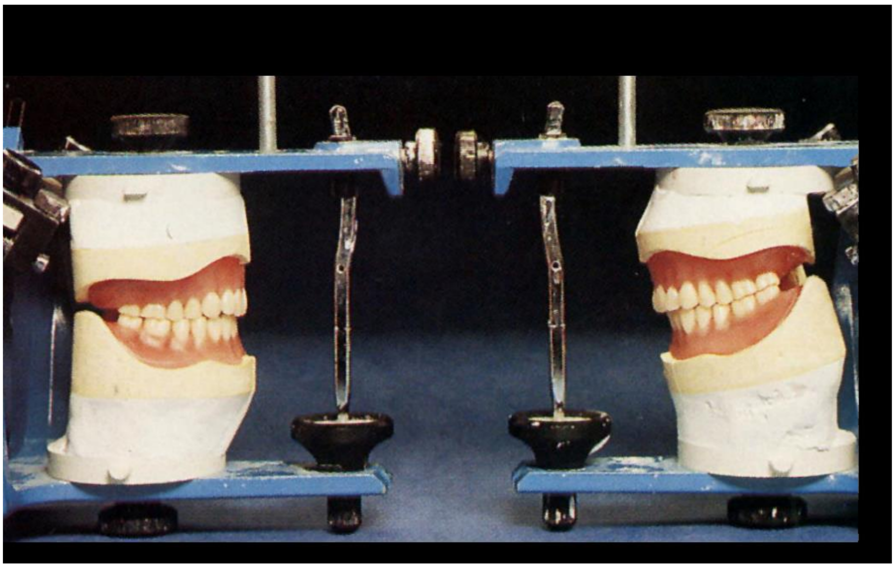




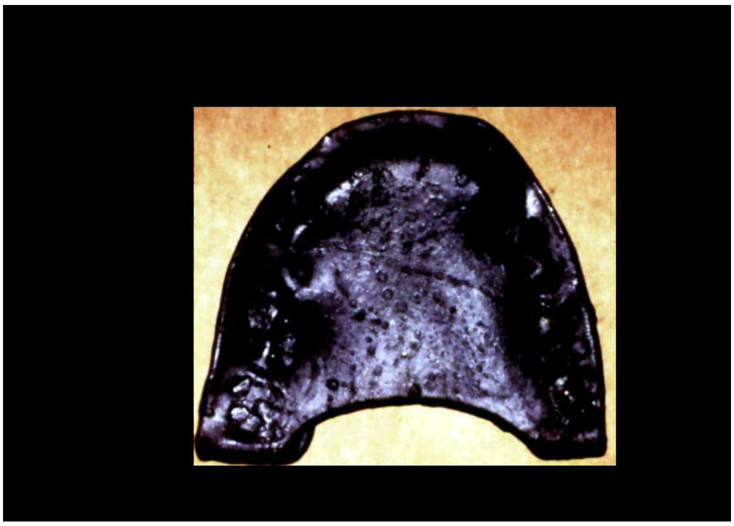
Facebow/Ear bow record is taken, to minimize the occlusal error.



With facebow record



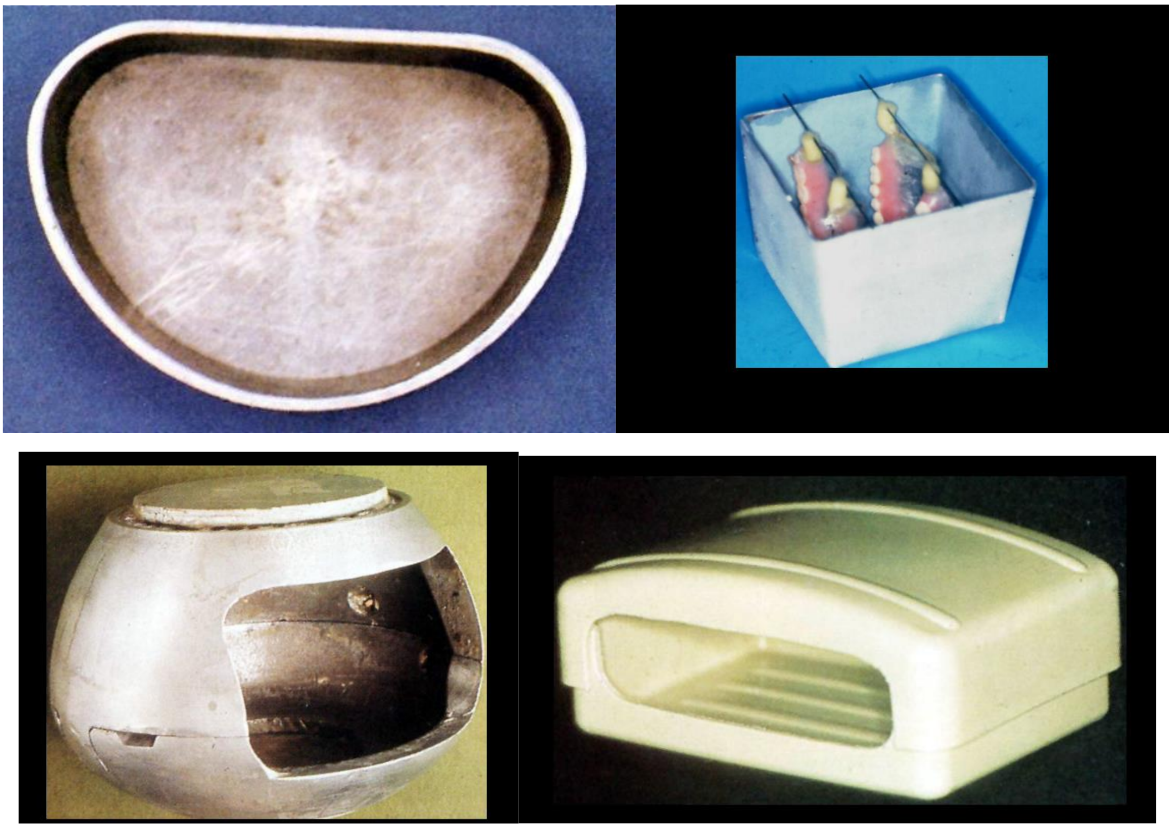
Without Facebow record



Intra-oral C R Record is also obtained.

Laboratory procedures for denture duplication

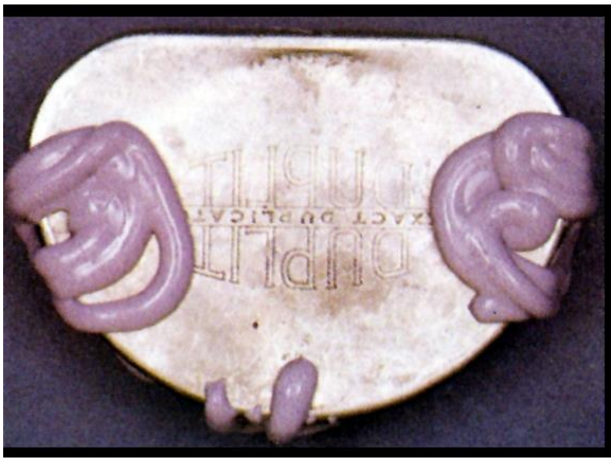
Impressions of the dentures are recorded in alginate using a suitable rigid container, such as a duplicating flask, a modified denture flask, or a soap container.



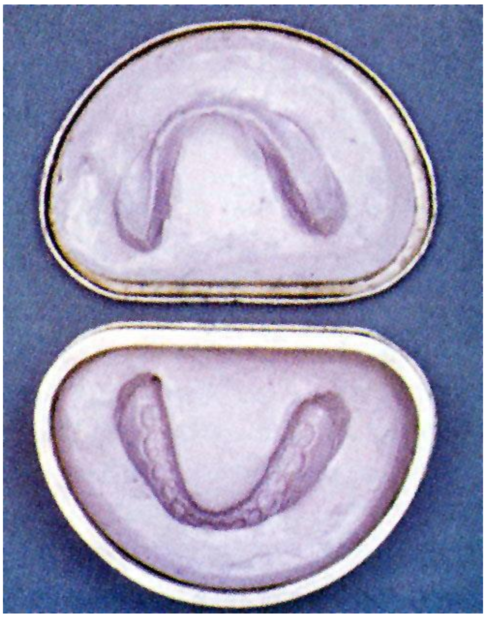
Type of containers to be used

The denture is submerged in alginate.

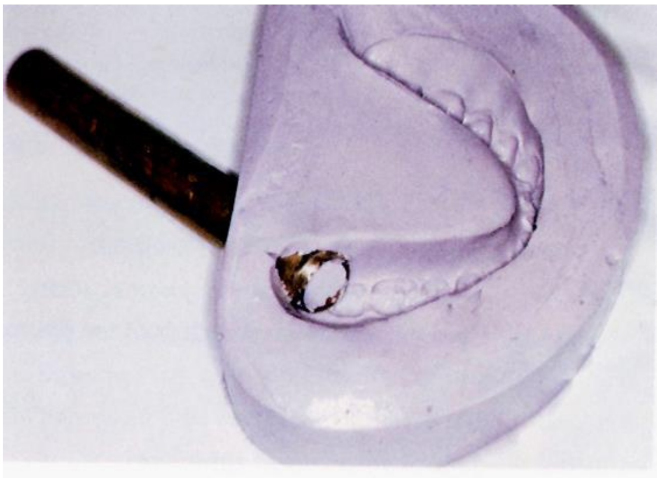
When the alginate is set, any flash of the material on the base is trimmed with a sharp knife.



The flask is then filled with a new mix of alginate avoiding any air entrapment, and the lid is closed.



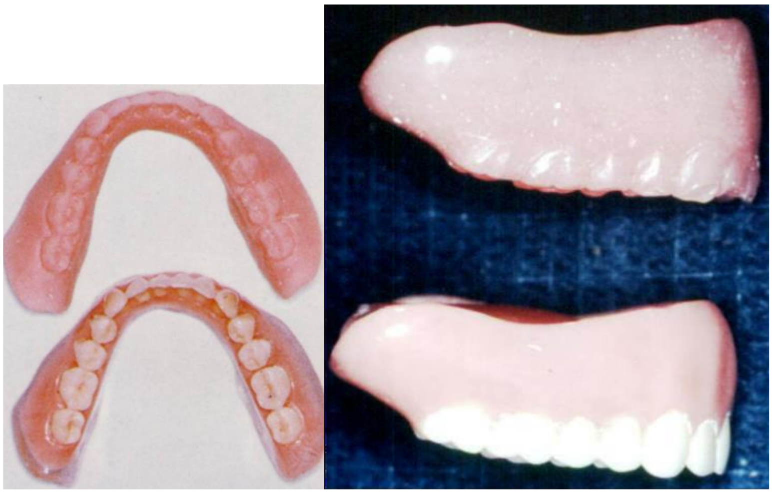
Alginate halves are separated and the denture is removed. It is returned to the patient.



Sprue holes are then cut into the posterior border of the alginate mold.

The impression is reassembled and held together with adhesive tape Auto-polymerizing resin is then run into one of the sprue holes until it rises from the other

Lastly, the duplicate monochrome denture is removed from the flask and mounted on a suitable articulator. Then the pink-colored teeth are replaced by the selected mold of the teeth.

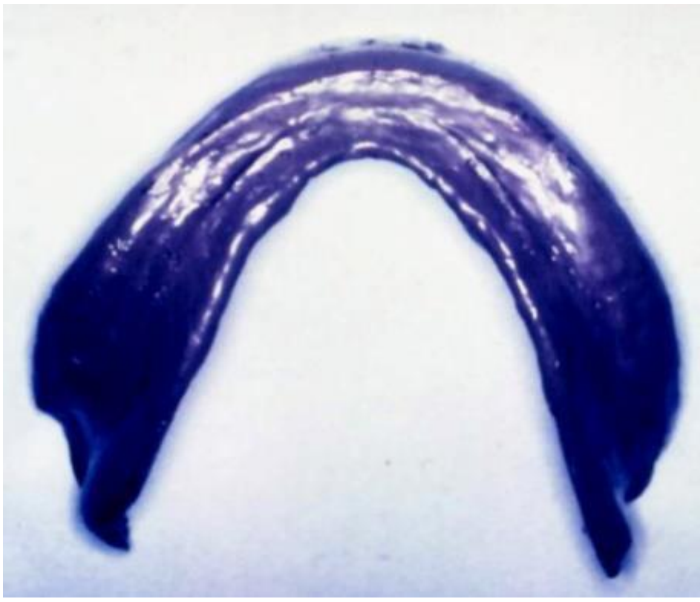


Original and Auto-polymerizing resin Upper & Lower Template dentures

2nd visit

This visit includes a try-in of the dentures – verification of the jaw relations and tooth positions for esthetics and phonetics.

A relining / rebase impression is then obtained as in the conventional reline technique.



Lower denture reline impression

Laboratory Procedure

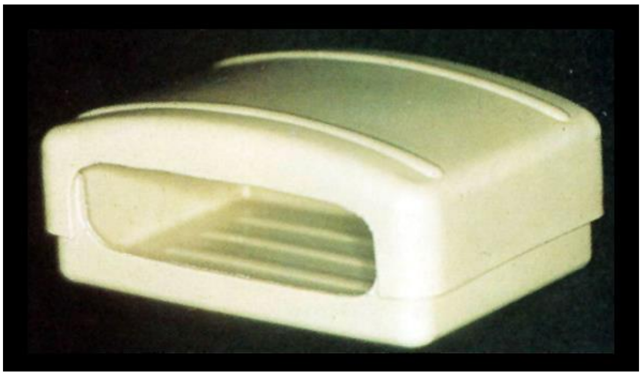
The dentures are now processed, finished, and polished with routine laboratory procedures.

3rd visit:

This visit includes all the necessary clinical procedures performed at the insertion appointment of a complete denture including the PIP adjustment and occlusal adjustments.

A clinical remount procedure should also be carried out to perfect the occlusion of the duplicated dentures

Denture Duplication Technique 'The Soap Container'



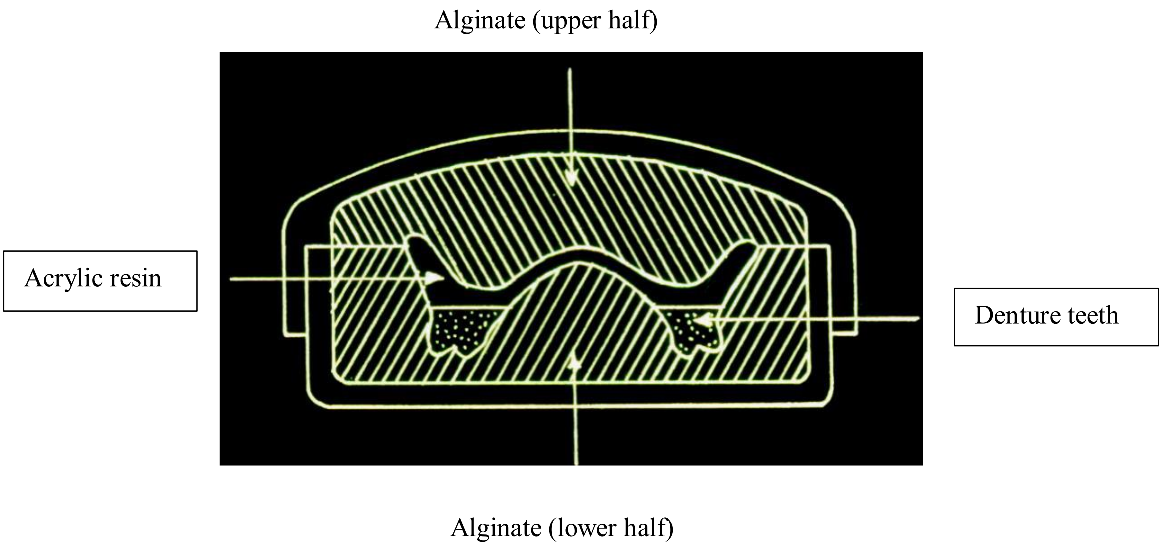
The Soap container

Denture borders are modified with a green stick compound.

It is then submerged in alginate in the soap container.

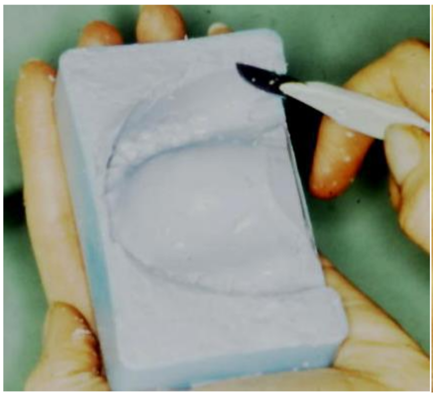
Denture invested in the lower part of the container.

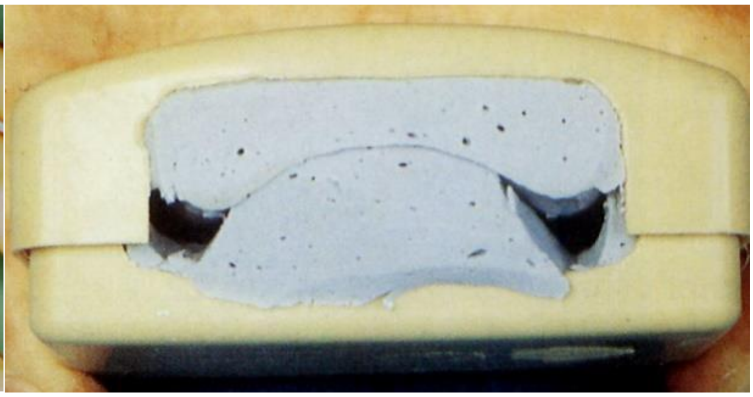
Second pour of alginate to complete the investment procedure – the soap container should be pressed from the sides to avoid its distortion.

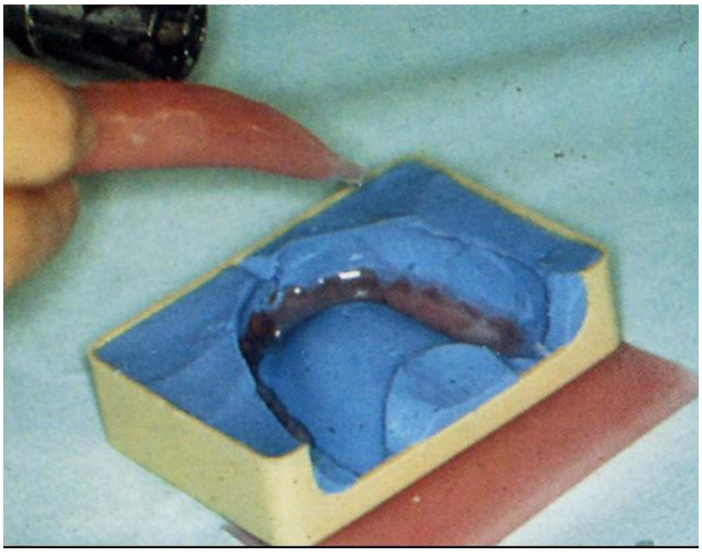


Line drawing showing the mold components

Two halves are then opened and the sprue holes (the diameter of a pencil) are cut with a sharp knife. The halves are then re-assembled and can be held together with elastic bands.





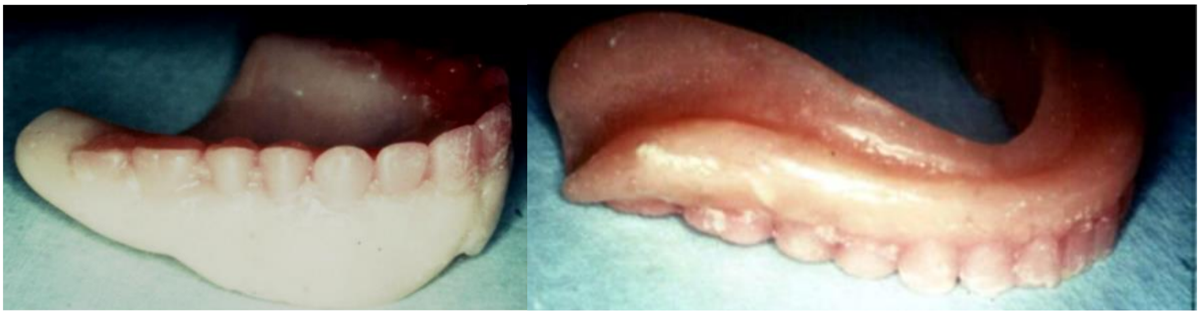


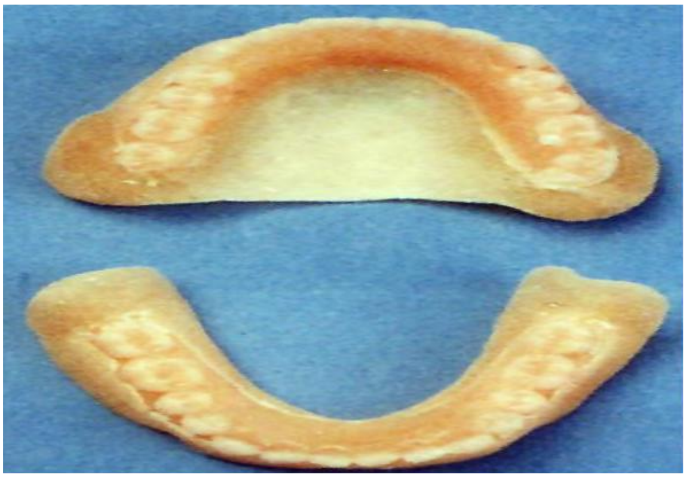
Replication of teeth in Wax.

Wax horseshoe representing the teeth

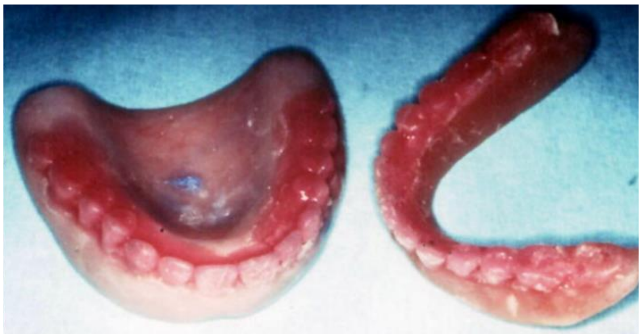
Two halves together – self-cure resin is being poured down one of the holes with light vibrations, while the air escapes from the other. Place the container with the sprue holes upright in a pressure pot that contains water at 110˚F and process the resin under 15-30 psi pressure for 30 minutes.

The Waxed or Auto-polymerized duplicate dentures are then recovered from the molds.

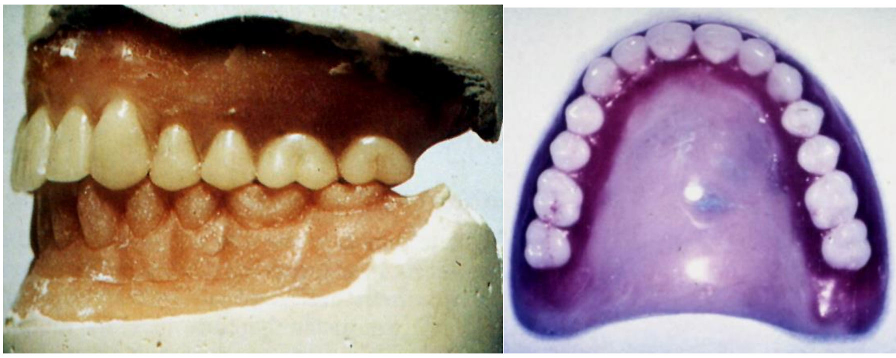




Upper and lower Templates with waxed teeth and self-cured acrylic resin bases.



A centric relation record is obtained after adjusting the waxed teeth for the OVD.



The wax teeth on one of the dentures are replaced with the identical mold of the resin teeth. The opposing denture guides are then set up in an identical position to the original denture.

Denture Duplication Technique 'The Silicon Putty'

An 80 years old patient wearing 25 years old dentures. Note a marked reduction in the OVD.

However, the patient is satisfied with the appearance of her old dentures and wants to have similar features in the new dentures as well – Hence the template or duplicate dentures are indicated.

The intra-oral occlusion of her old dentures suggests anterior crossbite– indicative of alveolar ridge resorption.

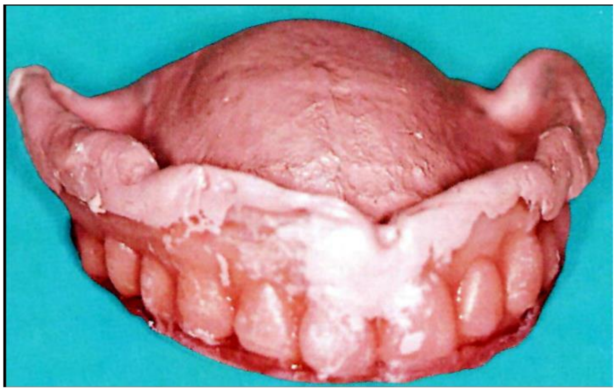
However, extra-orally the dentures can be occluded in normal centric occlusal contacts.

Silicone putty molds are produced and shellac record bases are adapted on the impression of the fitting surface. The molds are then closed and filled with molten pink wax to produce the replica of teeth.

The duplicate wax denture

The old denture

Manipulation of the wax replica dentures is then carried out to correct any errors in the old dentures, e.g., OVD.



An upper reline impression is obtained after adjusting the occlusal plane level and the OVD of the wax replicas.

The duplicate dentures are then mounted on a suitable articulator to replace the wax teeth with the selected mold of the teeth.

The tooth arrangement is guided by the old dentures

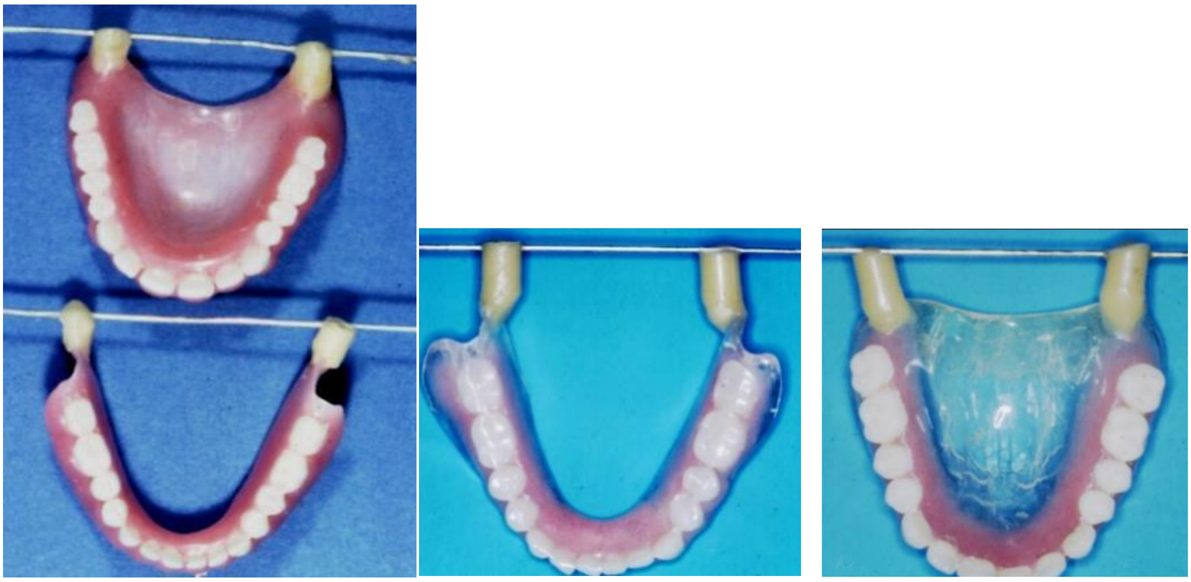
The relation of the ridges allows the new tooth arrangement to follow the original pattern.

Intra-oral Wax try-in is essential to verify the esthetic and phonetic virtues of the modified duplicate dentures.

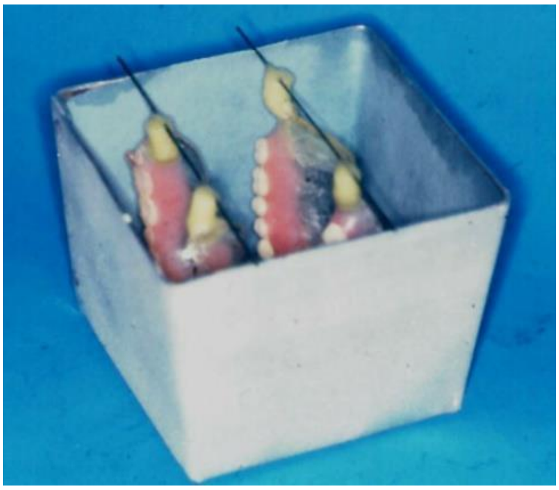
The new dentures can be recognized as the improved version of the old denture.

Old Dentures vs. New ‘duplicate’ Dentures

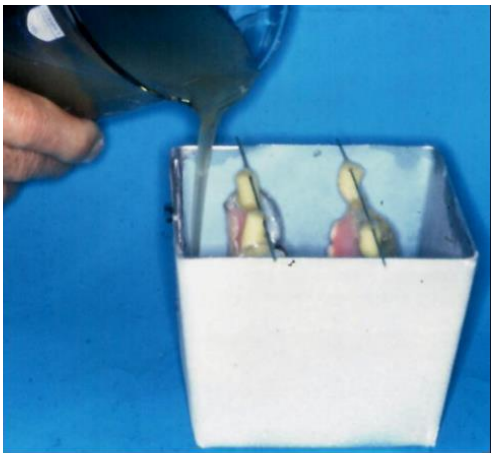
Denture Duplication Technique ‘the Agar-Agar’



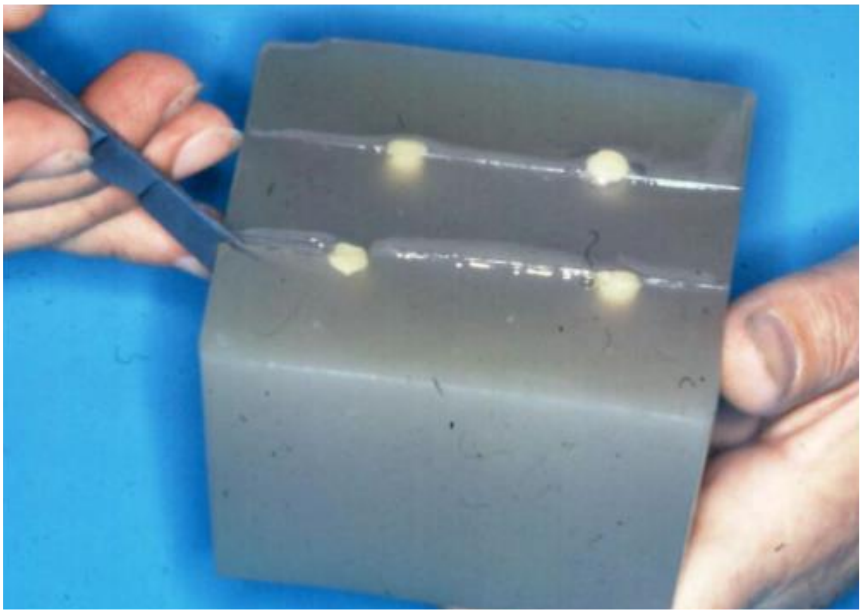
Dentures are suspended with a metal rod through the sticky wax sprues



Both Dentures are suspended in the agar container.



Molten Agar is poured into the container.



Once Agar is set, the mold is sectioned through the sprue holes to retrieve the dentures.

The mold space after removal of the denture.

Auto-polymerized acrylic resin is then poured into the mold space to produce template dentures for modifications.

Denture Duplication Technique Modifications / Further Applications

1. Addition of a labial flange to the open-face denture
2. Production of Temporary dentures Teeth are fabricated with dentin-colored self-cured acrylic resin before adding tissue-colored pink denture base resin.

Problem Areas in Fabrication & Solutions

1. Rigidity of the Box

The container used for fabricating the alginate mold must be rigid to avoid distortion of the alginate and subsequently the self-cured acrylic resin template. Precautions must be taken so that the rubber bands used to hold two halves of the mold must not distort the soap container.

2. Distortion of the Alginate ridge

Immediately after pouring the wax to form template teeth, the mold should be reassembled to check that the alginate impression of the ridge does not indent the soft wax. Wax is removed if necessary to avoid any possible distortion of the alginate ridge and production of a base plate without an intact all-acrylic resin impression surface.

3. Impression & Jaw relation records

These steps should be performed with utmost care. Silicone impression material is recommended for obtaining the reline impressions as the template dentures have to be re-inserted in the mouth for recording the OVD and Centric Relation.

4. Tooth position and Tissue contours

Since the spatial positioning of the teeth and the resin contours of the polished surfaces are important for neuromuscular control, the selection and placement of the stock (ready-made) teeth on the templates must be undertaken with great care.

MAXILLOFACIAL PROSTHESIS

Lec.18,19 **د.صفوان عبد الحميد**

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

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

Maxillofacial defects may be caused by congenital malformation, trauma or surgical resection of tumour.

Indications of maxillofacial prosthesis:

1. When plastic surgery is contraindicated.

2. When recurrence of malignancy is expected.

3. When radiotherapy is being instituted, radium appliance and radium protector shield can be used.

4. Temporary maxillofacial Prosthesis can be used when plastic surgery requires various steps.

Objectives of maxillofacial prosthesis

1. Improve or restore the aesthetics or cosmetic appearance of the patient which is of prime importance for everybody.

2. Improve or restore the functions that include:

a. Speech functions in patient with palatal lost part of the jaw.

b. Nutritional function in patient with lost part of the jaw.

c. Avoid escape of food to nasal cavity in children with cleft and overcome feeding problem.

3. Protect the tissues:

   a. To protect the adjacent tissue as in radium protective, also to protect wound, stop bleeding and carry medication after surgery.

   b. Protect the teeth as in mouth guard contact sport.

4. Therapeutic or healing effects by placement of radium applicator.

5. Physiologic therapy: to raise the moral of the patient + Help in healing fracture segments in cases of fracture face.

Maxillofacial team member

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

11. Neurologist

12. Physiatrist.

Maxillofacial Classification

Patients can be categorized by maxillofacial defects that are:

- **Acquired defects:**

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

- **Congenital defects:**

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

- **Developmental defects:**

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

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

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

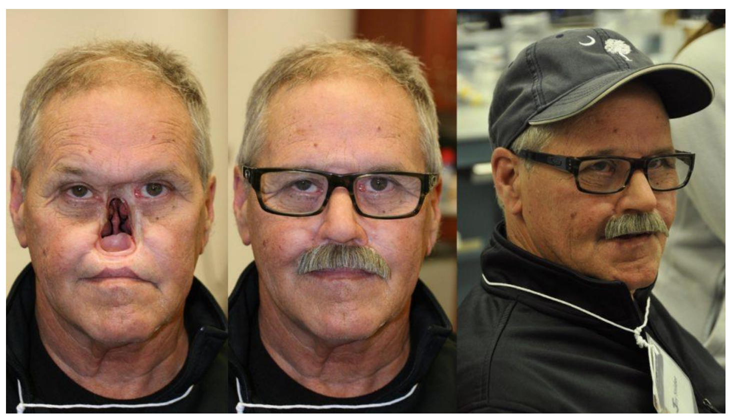
Extra Oral Appliances

1. **Nasal prosthesis**
2. **Auricular prosthesis**
3. **Orbital Prosthesis**
4. **Radiation Carrier**

5. **Cranial prosthesis.**
6. **Carrier Stent**

Nasal prosthesis:

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



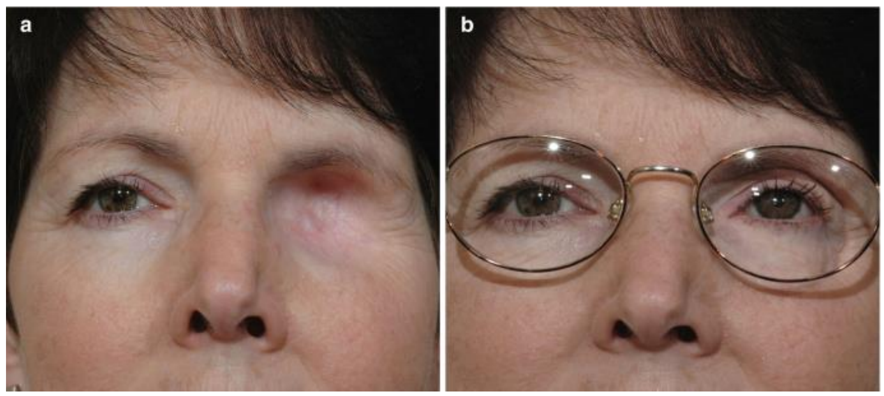
Auricular prosthesis:

An artificial ear produced from a previously made mould. Unfortunately, the presence of hair and the absence of anatomic irregularities often result in unfavourable adhesive retention of auricular prosthesis. Endosseous implants may permit positive retention of auricular prosthesis.

Orbital Prosthesis:

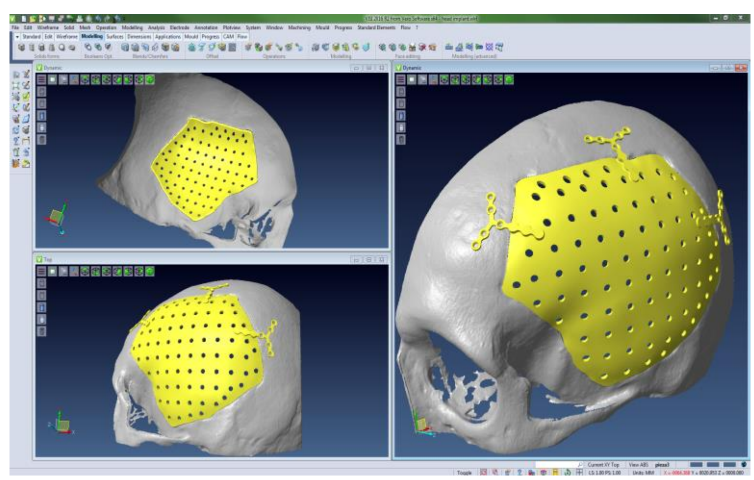
- Loss of eye is emotional and physical problem to the patient.

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



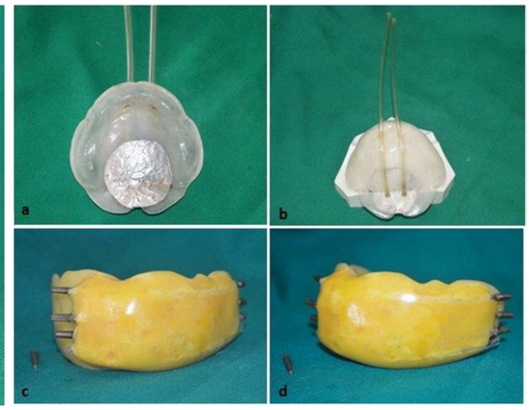
Cranial prosthesis:

A biocompatible, permanently implanted replacement of a portion of the skull bones.



Radiation Carrier

A device used to administer radiation to confined areas by means of capsules, beads, or needles of radiation emitting materials such as radium or cesium. Its function is to hold the radiation source securely in the same location during the entire period of treatment.



Preloaded carriers *After loaded carrier*

Radiation oncologists occasionally request these devices to achieve a close approximation and controlled application of radiation to a tumour deemed amiable to eradication.

Synonymous, Radiation Applicator, Radium Carrier, Radiotherapy Prosthesis.

Carrier Stent

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

Intra Oral Appliances

1. Obturator.

2. Feeding prosthesis

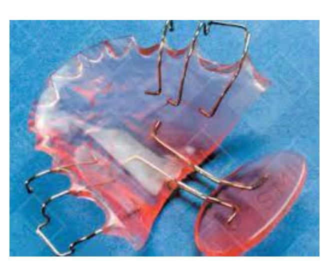
Figure 6: Feeding plate prosthesis

Figure 4. Prosthetic feeding plate inserted into infant's palate.

3. Mandibular prosthesis.

4. Speech prosthesis.

5. Palatal lift prosthesis.



OBTURATORS:

A maxillofacial prosthesis used to close, cover or maintain the integrity of the oral and nasal compartments resulting from a congenital, acquired or developmental disease process, i.e., cancer, cleft palate, osteoradionecrosis of the palate.

The prosthesis facilitates speech and **deglutition** by replacing those tissues lost due to the disease process and can, as a result, reduce nasal regurgitation and hypernasal speech, improve articulation, deglutition and mastication. *An obturator prosthesis is classified as:*

- *surgical,*
- *interim or*
- *definitive and reflects the intervention time period used in the maxillofacial rehabilitation of the patient.*

Functions of obturator:

The obturator fulfils the following functions:

1. Feeding purpose.

2. Maintains the wound/defective area clean and hold dressings or packs post surgically in maxillary resections.

3. Enhances the healing of traumatic or post-surgical defects.

4. Helps to reshape/reconstruct the palatal contour and/ or soft palate.

5. Improves speech.

Surgical obturator

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

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

Advantages of surgical obturator:

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

Interim Obturator

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

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

• Correction of tissue – prosthesis relation can be made by relining.

• The temporary obturator will need to function comfortably for as long as 6months.

• The timing depending on the size of the defect, the progress of the healing, presence or absence of teeth.

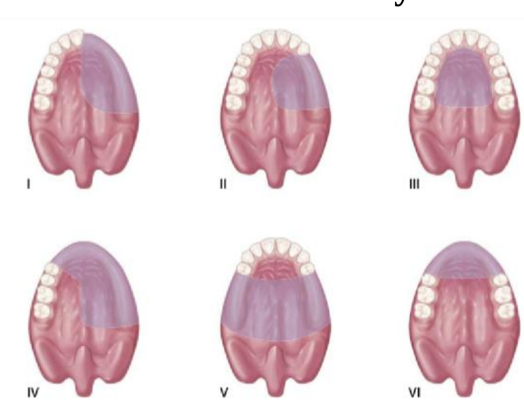
Definitive obturator

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

Reasons for doing constructing new definitive obturator:

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

Aramany's classification for partially edentulous maxillectomy dental arches:



Class I: midline resection.

Class II: unilateral resection.

Class III: central resection.

Class IV: bilateral anteroposterior resection.

Class V: posterior resection.

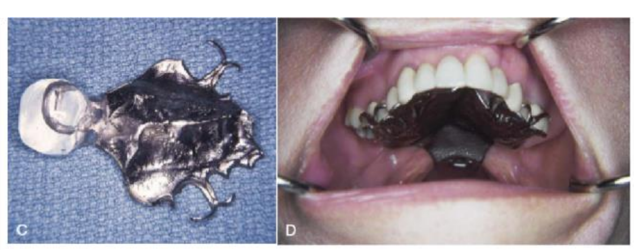
Class VI: anterior resection.

Feeding Prosthesis, feeding aids

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

Speech Aid Prostheses:

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

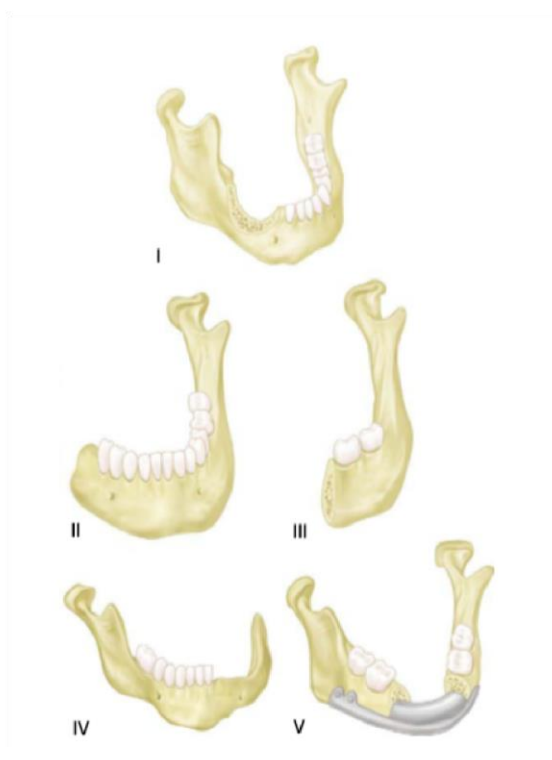


Palatal lift prosthesis

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

Mandibular resection prosthesis:

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



Cantor and Curtis classification of mandibular resection:

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

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

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

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

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

Retentive Aids in Maxillofacial Prosthodontics

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

Retention Methods:

1. Anatomic Retention

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

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

2. Adhesives:

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

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

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

Advantages:

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

Disadvantages:

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

3. Mechanical Retention

Current mechanical means for retention of facial prostheses include: -

• **Eyeglass:**

A possible means of retaining a nasal prosthesis by utilizing newly designed eyeglass frames for the patients who has had the bridge of the nose surgically removed. The eyeglass frame should be opaque in color rather than translucent to prevent retention marks from becoming visible.

• **Magnets:**

Magnets used widely in the retention of maxillofacial prosthesis and in different ways.

The traditional over denture by implanting pole in the jaw or soft tissue and the other pole fixed inside the prosthesis.

Magnets used in the joining of large prosthesis like in the treatment of patient with total maxillectomy and limited moth opening, the prosthesis composed of two parts and the magnets connect these parts after insertion these parts separately. The magnets also used to connect the prosthesis with intra and extra oral parts.

Magnets used for retention of extra oral prosthesis like auricle.

The repulsion effect of magnets used in retention of the upper and lower dentures by fixing magnets at the posterior area of the dentures made from the same pole.

- **Cast clasps:**

The most common method for retaining an intraoral prosthesis uses a cast metal clasp which enters an undercut. The properly designed and fabricated clasp will provide stability, splinting, bilateral bracing, and reciprocation, as well as retention.

- **Acrylic buttons and retentive clips:**

Acrylic buttons – retained facial prostheses usually have an acrylic substructure that fits into the defect and one or more mushroom – shaped acrylic projections (buttons) attached to the substructure. The final prosthesis is fabricated so that it will snap over the mushroom buttons for retention.

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

- **Implants:**

The successful clinical development of intraoral and extraoral implants to retain dentures and other prosthetic replacements.

The retention of prosthesis to implants by using ball and socket or by using the magnets.

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

Extraoral prosthesis retained by using osseointegrated implants which implanted in the facial bones to support the facial prostheses.

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

Steps of maxillofacial prostheses construction

1. **Primary impression**:

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

Silicone impression material can be used. In some cases, 2 compatible impression materials can be used in modified technique. The impression must extend as possible in the defected areas.

The primary cast obtained was used to fabricate a custom tray for the definitive impression. Any undercuts may interfere with tray construction must be blocked.

Relief areas must be determined also.

2. **Final impression**

The definitive impression is made a properly extended and well-adjusted special tray was made; sectional trays or double trays technique can be used.

Proper border moulding and proper extension of the flanges must be established.

- **Digital Impressions**

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

3. **Jaw Relation stage**

• Minimal block out should be made because excessive block out result in unstable record base.

• Improve aesthetic by an attempt to compensate for the loss of facial support on the defect side.

• Occlusal plane and wax level is difficult in most cases due to the tissue scar and block out procedure.

Transfer the jaw relation to the

• Semi adjustable articulator.

• Monoplane occlusion used for those patients.

4. **Try in stage**

In this stage should verify:

• Centric jaw relation

• Vertical dimension.

• Aesthetic.

5. **Delivery stage**

• Use of pressure indicating paste to check for pressure areas.

• Remounting of prosthesis for occlusal adjustment.

• Give instruction to the patient to maintain good oral hygiene.

Lec. No. ***Over denture***

The overdenture: is any removable dental prosthesis that covers and rests on one or more remaining natural teeth, the roots of natural teeth, and/or dental implants; a dental prosthesis that covers and is partially supported by natural teeth, natural tooth roots, and/or dental implants. (GPT. 9, 2017). The overdenture is also called overlay denture, overlay prosthesis or super imposed prosthesis.

The important goals of overdenture:

1-Maintains teeth as part of the residual ridge
- More support
- Withstands more occlusal load.
- Retention improve

2-Decrease in the rate of bone resorption. Alveolar bone exists as a support for teeth.
3- Retaining the proprioception.
4- An increase in the patient's manipulative skills in handling the denture.

Indications of Overdenture.

1-few remaining teeth unsuitable for fixed or removable partial dentures.
2- Remaining teeth present with unhealthy periodontal condition.
3- Patients with class II or class III Angle's classification - Esthetics & masticatory function improved.
4- Patients presenting abnormal jaw size large maxillary or mandibular bone defects.
5- The construction of over-denture is an alternative line of treatment to single dentures opposing few natural teeth.
6- Patients presenting congenitally missing teeth and congenital defects as cleft palate, microdontia, amelogenesis or dentinogenesis imperfecta or partial anodontia.

Contraindications of Overdenture:

1- Poor oral hygiene.
2- Inter-arch space inadequate to accept the denture and the abutments.
3- Mentally and \or physically handicapped.
4- Cost and time considerations.
5- When other treatment modalities promise superior results.
6- Lack of patient acceptance.

Advantages of overdenture prosthesis

1. Preserving the remaining residual ridge by decreasing the rate of bone resorption.
2- Preservation the abutments as part of residual ridge to gain support.

3. Preserving the response of proprioceptive exist in the periodontal membrane of the abutment tooth.
4- The modified teeth provide a definite vertical stop for the denture base
5-Horizontal and torque forces are minimized.
6-Stability and support are increased
7-Patient acceptance and Psychological Benefits
8-A Simple Approach to the Problem Patient.
9-fewer post insertion problems
10- Convertibility& effective management.
11-Periodontal Maintenance.(by distributing the applied forces over the remaining teeth) physiological stimulation.
12- Provide retention through the attachments.

Disadvantage of overdenture:
1. The susceptibility of the overlaid teeth to caries is high.
2. Periodontal disease of the retained teeth.
3. Bony undercuts of the alveolar ridge are often found adjacent to retained teeth over contoured (bulky denture) or under contoured flanges especially in canine eminence.
4. Encroachment interocclusal distance beyond the denture space.
5- Overdenture construction is time consuming and expensive.

Overdenture Classification: *Overdentures can be classified into:*

1-tooth supported

A complete or partial removable denture supported by tooth or retained roots that is intended to provide improve support, stability and tactile and proprioceptive sensation and to reduce ridge resorption. The tooth -supported over denture is also called overlay denture, telescopes denture and biological denture are among the many terms used to define the tooth-supported complete denture.

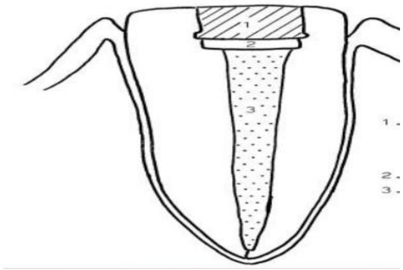
2-implant supported

The denture appears like traditional prosthesis. However, that part of the denture overlying implants is modified to retain various attachments that receive implant extentions projecting above the gum.

Classification of tooth supported overdenture Based on the method of abutment preparation:

1. Non coping abutment

- The tooth is reduced to a coronal height of 2 to 3 mm.
- The crown is contoured to a convex or dome shape.
- The tooth is endodontically treated and filled with amalgam or composite restoration.



2. Abutment with coping preparation

- A coping is a cover for the exposed tooth surface.
- Cast metal copings with a dome shaped surface and a chamfer finish line at the gingival margin.

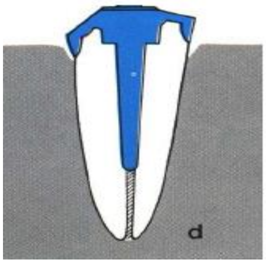
There are two types of copings:

A. Short copings

B. Long copings

<u>A- Short cast copings</u>

2 to 3 mm long (cast coping has a post is fitted to endodontically treated canal).

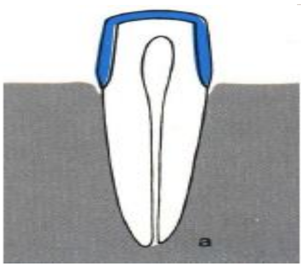


<u>B-Long cast copings</u>

- 5 to 8 mm long abutment
- Endodontic treatment is not a must (abutment is prepared

Conservatively to prevent pulp involvement to receive the cast)

- Greater level of osseous support.



3- Abutments with attachment

- ❖ Attachment is small precision device
- ❖ Most attachment are secured to the abutment by cast coping.
- ❖ Objective to improve retention of denture base.
- ❖ Consisting of 2 parts
  - Male
  - Female

4. Submerged Vital Roots

This additional abutment category, this method is innovative attempt to overcome some problems associated with the more conventional overdenture abutments included caries, gingivitis, periodontitis and the need for endodontic therapy. This method included vital roots are transected and reduced to 2mm below the crestal bone and covered by mucoperiosteal flap. The disadvantage of these method dehiscences over the retained roots and pulp pathosis.

5-Abutments with telescopic crown

- Abutment teeth are either vital or endodontically treated &contoured to tapered configuration.
- Tapered metal copings constructed &cemented over abutments
- Denture constructed with metal crowns having veneered facings.
- Indicated 1) unparalleled abutment 2) uneven spaces between abutments 3) useful for obturators
- Advantage increased retention and stability
- Disadvantages bulky crowns.

Classification of over denture based on the type of the over denture

1. Immediate overdenture

The remaining teeth are reduced to accept the overdenture (on the cast), the overdenture are constructed prior to the preparation of abutment teeth and is inserted after the preparation.

2- Transitional or intermediate overdenture

Used for patient in transition or preparation phase until permanent overdenture constructed or patient with old partial denture and add new artificial teeth using self-cure acrylic resin.

3-definitive overdenture

Conventional complete over denture constructed over one or more abutment teeth. Could be made entirely of acrylic resin or in conjunction with metal bases.

Uses of overdenture concept in other areas

The overdenture approach has applications besides the obvious replacement of complete denture therapy or extensive restorative dentistry

Congenital and acquired defects:

Patients presenting with such anomalies as cleft palate microdontia, amelogenesis imperfecta etc…the overdenture application can afford a very workable and relatively simple solution to patients with selected problems. The important benefit is that the technique is totally reversible.

Partial overdenture

The use of an overlaid tooth that might otherwise be extracted to give posterior support to distal extension base or to provide anterior support for a large anterior supply on a partial denture renders obvious support advantage.

Sequence of Treatment of Patient Who Need an Overdenture

A-Assessment of the patient

1. History (general and oral).
2. Clinical examination (visual and digital examination, radiographic examination and study model of the arch).
3. **B-Treatment plan**

   Evaluation the abutments

1-Periodontal status.

2-Endodontic considerations

3-The number and position of abutment teeth in the arch

<u>1-periodental status</u>

- Minimum mobility.
- Have acceptable bone support, 5-7mm.

- Amenable to periodontal therapy.

2-endodontic consideration

The tooth must be treated endodontically to allow for sufficient reduction of clinical crown, ideally patient with single rooted teeth with only one canal are the best candidate although multirooted teeth can also be used.

3-the number and position of the abutment teeth in the arch

In maxillary arch incisors are used, at least one tooth per quadrant should be present, ideal is 2 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 Canine, reasons – Position, Large surface area, The Canine response, Time period of retention of the tooth, less susceptibility to periodontal breakdown, fewer anatomical and positional difficulties

periodontal treatment includes:

1. Initial therapy.
2. Surgical therapy.
    a. Root planning with direct visual access.
    b. Surgical reduction of periodontal pockets by gingivectomy and /or flap procedures.
    c. Surgical crown lengthening.
    d. Widening of the attached gingiva through mucogingival surgery.

Abutment Preparation

1-Simple Tooth Modification and Reduction

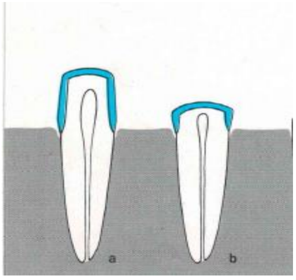
The teeth are reshaped to eliminate undercuts and to reduce the vertical height. This technique is often used in partially anandontic patient or in patient with sever abrasion of teeth.

Indication:

1. Good oral hygiene with low caries index
2. Vital pulp.
3. Partially anandontic patient.
4. Sever abrasion of teeth.
5. Sufficient interocclusal distance.

2- Tooth Reduction and Cast Coping

Cast copings are made after reducing the teeth to prevent sensitivity or as caries control. Endodontic is not done on these teeth; this technique is used when there is adequate bony support and good periodontal prognosis.

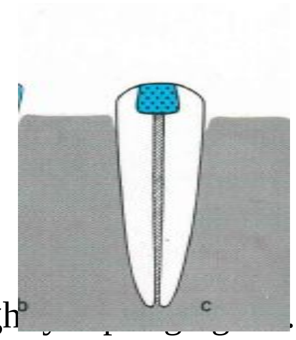


Indication:

1. Adequate bony support
2. Good periodontal prognosis
3. Adequate interocclusal distance.

3-Endodontic Therapy and Amalgam Plug

It is indicated when there is normal coronal height to the teeth and normal interocclusal distance with little or no loss of vertical dimension, endodontic therapy to the abutment then reduced (1-2) mm at gingival level to receive an amalgam type restoration.



4-Endodontic Therapy and Cast Coping

Shallow dome shape with the margin sligh . Recurrent decay on the exposed dentin when there is a history of carious involvement. The retention is gained from a short post that is placed within the root canal.

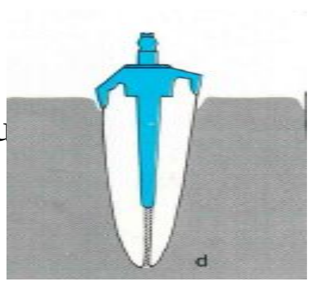


5- Endodontic Therapy with cast coping utilizing some form of attachment

Over denture retained by attachments offer the patient the idea of a fixed removable bridge instead of a denture. The abutments are prepared as in short-coping but with long intraradicular post to prevent root-coping dislodgment. Two attachments are enough to retain a denture, third attachment add unnecessary complexity and weakens the denture.

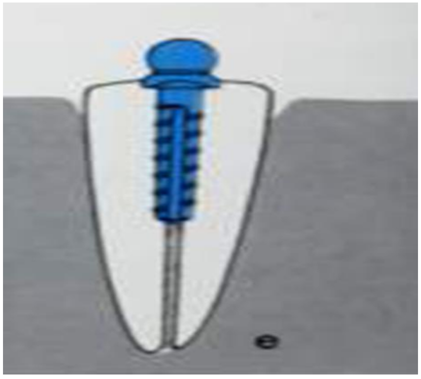
6-Endodontic treated tooth with prefabricated retentive element

It is a simple and inexpensive way to temporary fixation of overdentu



(Spherical retentive element attached to a threaded post).
Ex. (Dalbo-Rotex system).
The disadvantage of this type is that the omission of a protective coping increases the risk of carious destruction and root fracture.

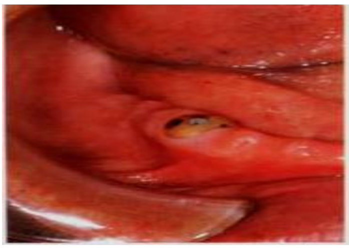
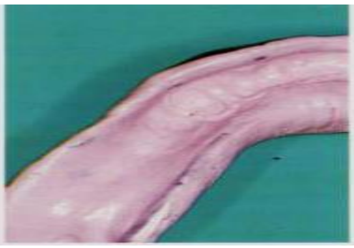




Impressions of the Abutment Teeth

One –stage technique with supporting element

For designs that rest on abutment teeth without root copings, the full-arch impression is made as soon as the abutments are prepared. When root copings without retentive elements, the impression is made after final cementation of the copings, the full arch impression is made in a custom tray similar to one for conventional complete denture. It covers the entire ridge except for any undercut areas near the abutment teeth that could not be utilize for the future denture base any way. The impression is made using Zinc oxide-eugenol paste or elastomer in the same manner as in the edentulous arch.


One -stage technique with existing retentive element

A single step full arch impression in Zinc oxide-eugenol paste or elastomer the materials used for overdenture that will rest on Pre-existing retentive elements Transfer matrices are set in place on the involved retentive elements and picked up in the impression. this is make it possible to incorporate retentive elements analogs in the working cast, used custom tray similar to these used for complete denture, the tray must touch neither the root coping nor the transfer matrices.

Record base

The only difference in the construction of the record bases for tooth –supported overdenture and conventional dentures is the incorporation of the metal bearing in the record base. The shape of the record base must correspond to that of the future overdenture, i.e., it should not cover the facial marginal gingiva in the abutment region.

Denture Base designing

Criteria for Designing the Base

- Not unnecessarily promote plaque accumulation.
- Not mechanically traumatize the marginal gingival.
- Not impede the performance of good oral hygiene.
- Not interfere with normal function of the tongue, lips and cheeks.
- Not interfere with esthetics or speech

<u>Designs that leave the periodontium uncovered</u>

- ☒ The base does not cover the gingiva, and the artificial teeth are prepared to fit directly upon the roots or the dowel copings

1- Bases that are circumdentally open
2- Bases that is facially and proximally open.

- Temperatures in the gingival sulcus are significantly higher under closed bases that cover the gingival margin than with open designs. Gingival reaction was always most severe where the denture base covered the gingival margin and least severe in uncovered gingival margins.

Basic rules of overdenture base design

1. Cover as little of the marginal gingiva as possible
2. Border the proximal spaces with metal.
3. The greater the number of abutment teeth and the better their prognosis, the more open the construction may be.

Advantages of a base designed that it does not cover the gingiva

1. precludes direct mechanical trauma.
2. Reduce plaque retention around the abutments.
3. it possible to clean the proximal surfaces of the root coping with interproximal brushes with the prosthesis in place.
4. prevents a suction effect combined with inadequate coping shape and poor oral hygiene, would lead to hyperplasic proliferation (suction hyperplasia).
5. prevents undesirable vacuum retention in maxillary overdentures with retentive attachment.

Disadvantages

1. increased risk of fracture of the base
2. Unfavourable spatial relationships that do not permit extensive proximal openings
3. Esthetic considerations
4. increased food impaction in the open proximal spaces
5. Speech problems such as sigmatism
6. Poor prognosis for the abutment teeth, making probable an early conversion to a complete denture

Circumdentally opened design

Advantages

1. Possible to clean the abutments without removing the denture.
2. The base cannot traumatize the gingiva around the abutments.
3. minimal extension of the base

Disadvantages

1. very complex
2. The risk of fracture is greater
3. The possibilities are limited for modifying and adding to the denture when abutment teeth are lost.

Indications

- abundant space over the abutments

- a good prognosis

Facially and proximally open design

Have enough rigidity only if they incorporate custom cast reinforcing frameworks.

Advantages

- less involved technical construction,
- the reduced risk of fracture.
- the ease of modification when an abutment is seldom causes any problem with phonation or food retention.

Disadvantage

1. difficulty in cleaning
2. The greater extension of the denture base (psychological disadvantage)

Indications

- Poor prognosis
- speech problems
- extensive tissue loss in the anterio
- unfavorable spatial relations

2-Implant supported overdenture

An implant retained overdenture is an alternative form of treatment to the fixed-implant prosthesis. The denture may attach on a cast bar fixed to abutments, or it may attach to individual abutments. Patient can remove the overdenture for cleaning. Due to an increased awareness of the variety of clinical situations, bone density, biomechanics, and patient's desires, and an ever growing number of patients benefit from additional retention and support through the help of implant supported overdentures.

Type of implant overdenture

1-implant-retained and tissue-born overdenture

It depends primarily on residual alveolar ridge for support. The implants will provide support in the area of the arch in which they are placed when loading is directed over them, this type need less number of implant (depending on the quality and quantity of the bone for maxilla and mandible)

- 2-4 implants -------for mandible
- 3-4 implants------for maxilla

2-implant –retained and implant –born overdenture

It does not depend on tissue support but depended on implant to bear the total occlusal loading. This type requires the use of sufficient number of implants to accommodate the load placed on the prosthesis.

The minimum number of implant required:

- ☒ 4 implants ------------- for mandible
- ☒ 6-8 implants------------for maxilla

Indication of Implant supported overdenture.

1. The patient's general health allows only a short surgical procedure.
2. Atrophic ridge, therefore objective improvement cannot be expected by fabrication of new conventional dentures.
3. Patient has worn removable dentures previously.
4. Edentulous patients who are no longer able to wear complete dentures.
5. The patient is basically satisfied with complete dentures but wants the security of increased retention.
6. Economics: the patient is either unwilling or unable to bear the expense of a fixed reconstruct.

Contraindication:

1) Systemic conditions.
2) Inadequate bone substance for placement of at least two implants.
3) Unrealistic patient expectation.
4) Mental disorders.
5) Pregnancy
6) radiation to the implant site
7) Improper patient motivation

Consideration that determine the type of implant supported overdenture

1- Patients desire.
2- The quality and quantity of the bone in the arch.
3- The opposing occlusion.
4- The amount of inter-arch distance.
5- Economic considerations.

<u>Advantages of implant supported over denture:</u>

1. Prevent bone loss.
2. Maintain facial esthetics.
3. Reduce or eliminate prosthesis movement.
4. Create reproducible centric relation occlusion.
5. Eliminate soft tissue abrasions.
6. Improve prosthesis retention.
7. Increase occlusal force.

8. Improve prosthesis retention.
9. Improve chewing efficiency.
10. Improve speech compared with dentures.

<u>Disadvantages of implant supported over denture:</u>

1. Eliminate bone grafting or implants with poor prognosis for fixed restorations.
2. Some patients want implants primarily because they do not want to be able to remove the prosthesis. This would not satisfy the psychological needs of these patients to feel that the prosthesis is part of their body.
3. Lack of sufficient inter-arch space makes an overdenture system more difficult to fabricate than a porcelain fused to metal fixed prosthesis and more prone to component fatigue and failure.

Requirments of implants used:

•Distance between bar-connected implants must be no less than 8 to 10mm, so that the lengths of the bar segments between implants are sufficient for proper placement of the retention clips.
•Arrangement of the implants should be as symmetrical as possible.
•Points of emergence of all implants should lie at the same height.
•In mandible, two implants may be sufficient.
•In maxilla, more than two implants recommended.

The removable implant supported denture may present certain advantages over fixed implant prosthesis such as:

1) Decreased costs associated with fewer implants.
2) Easier access for oral hygiene procedures.
3) Improved facial support via denture flanges.
4) Improved esthetics and phonetics, particularly in the maxillary arch.

Over Denture *(Continue)*

Attachments in over denture

Attachments are small mechanical devices, they are incorporated to provide retention and support, one part is connected to a root, tooth or implant (male part) and other part to a prosthesis (female part)

Function of attachment

1- Securing the prosthesis against forces that tend to lift it.

2- Providing periodontal support for the prosthesis.

3- Transferring the forces of the muscles of mastication from the prosthesis to the periodontium in as nearly axial direction as possible

4- Distributing shearing forces.

5-Stabilizing and/or splinting the abutment teeth

Factors affecting attachment selection

1. Available inter-arch space.
2. Crown root ratio and alignment of the roots.
3. Type of coping.
4. Vertical space available.
5. Number of teeth present.
6. Amount of bone support.
7. Location of abutments.
8. Location of the strongest abutments.
9. Whether the overdenture is a tooth supported or toothtissue-supported.
10. The type of the opposing dentition whether it is complete denture, overdenture, fixed appliance or natural dentition.

11. The maintenance problems and the cost.

12. Clinical experience and personal preference.

Retentive Mechanism

It is achieved by either:

1- Active retention provided by springs that fit into recesses.

2- Friction between the components.

3- Magnetic anchorage

Classification of Attachments

A- <u>Rigid attachments</u>

A retentive attachment is considered to be rigid if it is grasps the abutment tooth bodily and permits no movement between anchor and prosthesis except for rotation around the long axis of the element in case of a single tooth. Even with rigid attachment there is a minimal amount of movement, which can increase when the attachment wear.

Advantages:

1- Reduction of the load on the edentulous ridge during function and parafunction.

2- Minimum tipping of the abutment teeth when subjected to lateral forces.

Disadvantages:

Applied forces and movements of the denture are transmitted almost entirely to the abutment teeth

B- <u>Non rigid attachments</u>

Non rigid attachment permits rotational movements of the denture around the anchor in one or more planes, or vertical body movement's .The greater the number of the non-rigid attachments used in the same denture, the more limited will be movement of each.

Advantage: Reduced effect of tipping force on the abutment teeth.

Disadvantage:

-Greater stress on the tissues supporting the denture (Ridge resorption)

Non rigid attachments may be indicated under the following conditions:

1- When the geometric distribution of the remaining teeth is unfavorable for the stability of the denture. This can give rise to undesirable tipping and rocking movements especially if the soft tissue support is more resilient and/or less expanded than normal.

2- When only a short dowel (post) can be used to anchor the coping. If a rigid attachment were used over a short dowel, uncontrolled movement of the denture might loosen the dowel from the root

Types of attachments

<u>A-Stud attachments: (2 types):-</u>

1- Intra radicular attachments. (E.g. Zest anchor attachment).

2- Extra radicular attachments. (E.g. Ceka Revax attachment).

B- Bar attachments: (2 types):-

1- Bar units.
2- Bar joints.

C-Magnet attachments.

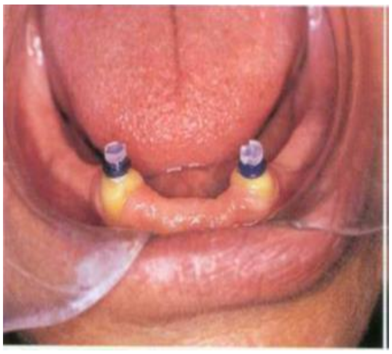
Stud attachment

•Male stud –soldered to the base which is a coping covering the prepared tooth stump
•Female housing –this is embedded in the acrylic of the OD or it is soldered to substructure in the OD
•Male and female attachments may be either resilient or non resilient

There are many systems of stud attachments*:*

1. Zest anchor (intraradicular attachment)

- Post prep is made within the root and the female sleeve is cemented into plac*e*
- Male portion consists of a nylon post and a ball head attachment to the overdenture as a chair side procedure
- Ideal for interim overdenture



Advantage

1. Overcomes any space problem since the attachment is within the root structure.
2. Leverage to the abutment tooth is reduced
3. Attachment procedure is simple

4. Parallelism is not necessary if more than one tooth is used due to the flexibility of the nylon
5. No casting is required

Disadvantage

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

2-Ceka Attachment (extra radicular attachment)

• Male part fixed 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

• Female housing fits over this

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

Patrix – metal ring

Matrix – attachment pin (split metal post)

3-Dalbo attachment

• Rigid, resilient or the stress breaker type

• Male part is soldered to the tooth and the housing to the base

• The rigid type has a cylindrical male unit with a rounded head

• The resilient is the smallest and the most commonly used.

• Rotational and vertical movement possible because of relief spacers between the units

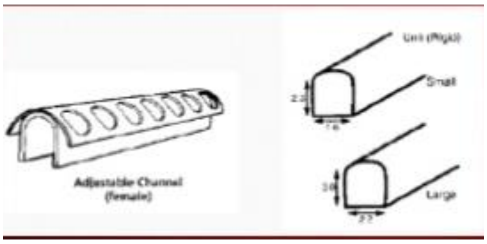
• Retention in this is by the flexible arms of the female unit fitting over the undercut head of the male unit

<u>Bar attachment</u>

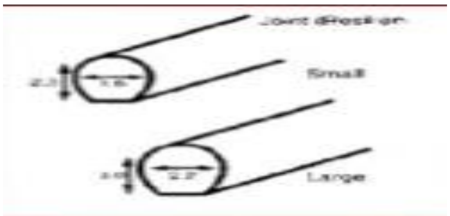
• The purposes of using bars are: – Splinting of abutment teeth – Retention and support of the prosthetic appliance.

• There are 2 types:

– **<u>Bar units</u>** : which are the rigid type, no movement between bar and overlying sleeve, transmits occlusal stress totally to abutments.

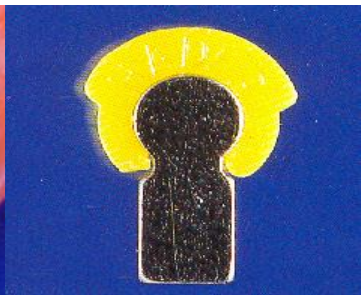
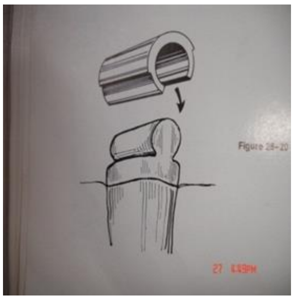
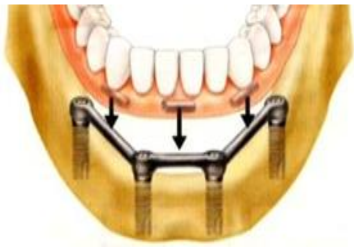


<u>– Bar joints</u>: which allow some movement of the rotational type. Utilizes the residual ridge for support .



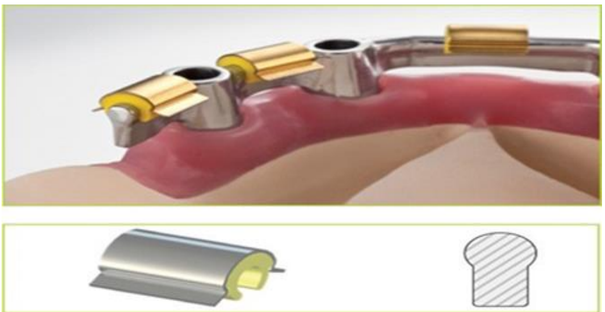
There are many systems of bar attachment such as:

- **<u>1- Hader Bar</u>**
- This bar can serve either as a bar joint or a bar unit or as stud .It consist of preformed plastic bars and clips .The bar is attached to the coping wax-up and is casted with the coping. The plastic clips can be imbedded in the denture base to gain retention.

2-<u>Ackerman clip and C.M. clip</u>

It consists of a round bar soldered to the post copings and the clip fits over the bar, It in addition has retention wings for engagement of the clip into the resin in the overdenture, spacer is supplied, so that the clip does not rest directly on the bar providing both rotational and vertical movement.

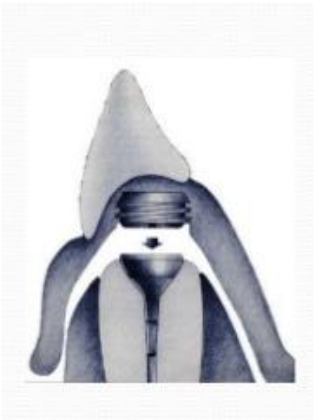
<u>3- Dolder bar</u>

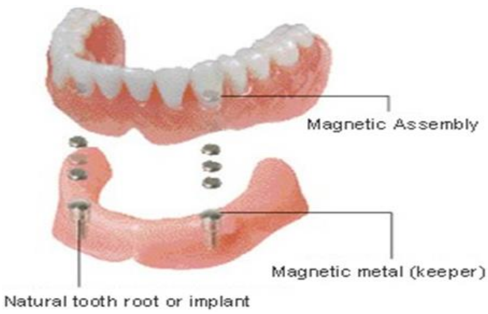
• <u>Bar unit:</u> preformed bar with parallel sides and rounded top soldered to the coping , Sleeve is present in the denture bases , Retention is due to friction ,If the post of the copings cannot be made parallel to seat the soldered bar then a schubiger unit is used . Because of the parallel walls and close adaptation rotation is not possible

• Bar joint: – Egg shaped bar with a spacer. This allows some movement – Difficult to adapt to tissue contour and bulky.

C-Magnet Attachments

Magnet system of cobalt - samarium magnet built into the denture base and a magnetisable dowel -coping or keeper plate of palladium cobalt- nickel alloy into the abutment teeth





O-Ring attachment

They are doughnut shaped, synthetic polymer objects that possess ability to bend with resistance and then return back to their original shap.The

O-ring attaches to a post with a groove or undercut area.

Advantage

- Ease in changing the attachment.
- Wide range of movement.
- Low cost.

- Elimination of time &cost of a superstructure of prosthesis.

Oral Hygiene Instructions

- Motivating and instructing the patient in the care of the overdenture is of the extreme importance for its long term success
- Learned during the preliminary treatment phase, the oral hygiene procedures practiced by the patient following placement of the overdenture should be an uninterrupted continuation of the home care measures.

Overdenture care

- 1- Ordinary toothbrush or a special denture brush.
- 2- Tooth pastes with low abrasiveness and non-alkaline soaps.
- 3- Denture cleansers (mostly peroxide based) are a useful adjunct.
- Candidacies can be treated by immersing the denture in a 0.2%chlorhexidine solution for 10-15 minutes every day

Care of abutment

A-mechanical aid

- All abutment teeth with or without root coping must be cleaned on all sides.
- All exposed root surfaces and gingival area should be brush again with an inter proximal brush.
- Dental floss is used only to clean under interdental bars and beneath root coping that are solder together.

B-chemical aid

Fluoride in gel
Fluoride in a 0.025% solution can also be used as a daily rinse.

Chlorhexidine:
0.1-0.2% solution as a daily rinse
gel to be applied inside the denture base or the female attachment.

Prosthodontics follow up care: - to correct

-Occlusion (remounting records).
-Base (relining).
-Pressure spots.
-Bar (loose screws).
-Bar clips (broken, loose).
-Female retainers and clips remounted with acrylic resin.
-Signs of wear

Neutral zone technique in complete denture

Lec.17 **د.صفوان عبد الحميد**

The stability of complete dentures is influenced by the surrounding neuromuscular system in the oral cavity. Oral functions, such as speech, mastication, swallowing, smiling, and laughing, involve the synergistic actions of the tongue, lips, cheeks, and floor of the mouth that are very complex and highly individual.

Neuromuscular control is the key for the stability of dentures. Size and position of denture teeth and the contours of polished surface play a crucial role in denture's stability as they are subjected to destabilizing forces from the tongue, lips, and cheeks if they interfere with the function of oral structures.

Neutral Zone: Is the potential space between the lips and cheeks on one side and the tongue on the other; that area or position where the forces between the tongue and cheeks or lips are equal. (GPT.9, 2017)

The Neutral Zone Philosophy:

It is based upon the concept that for each individual, there is a denture space which is a specific area where the function of the musculature will not unseat the denture and where the forces generated by the tongue are neutralized by the forces generated by lips and cheeks.

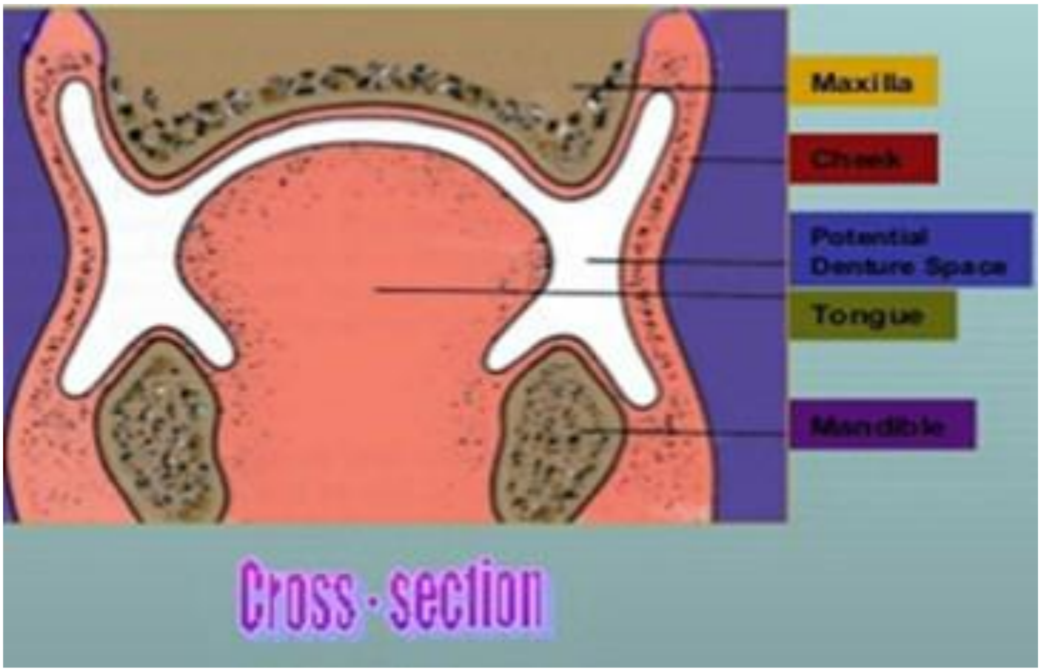
The Neutral Zone and the denture Space:

In complete edentulous patients a void in the oral cavity is called potential denture space.

Boundaries of denture space

- Maxilla and soft palate - superiorly

- Mandible and floor of the mouth - inferiorly
- Tongue - medially
- Muscles and tissues of cheek and lips - laterally



Neutral Zone Concept

Neutral zone is that area in the mouth were, during function, the forces of tongue pressing outward are neutralized by the forces of the cheeks and lips pressing inwards. Since these forces are developed through muscular contraction during chewing, speaking, swallowing etc. they vary in magnitude and direction in different individuals and in different periods of life.

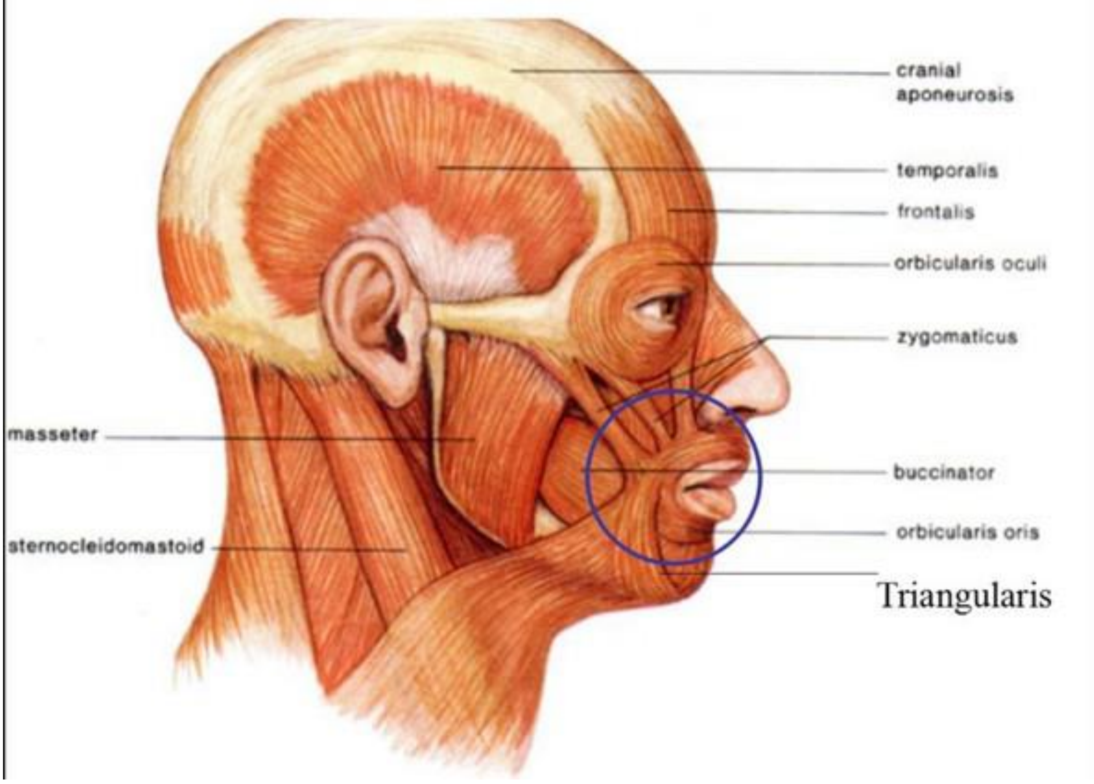
The way these forces are directed against the denture will either stabilize or dislodge them. Our objective is to utilize this information to so position the teeth and the external surface that the force the musculature exerts will have a seating effect. This can be only accomplished by a knowledge of neutral zone and by positioning the teeth and developing the external surface so that all the forces exerted are neutralized.

The central thesis of the neutral zone approach to complete dentures is '***to locate***

that area in the edentulous mouth where the teeth should be positioned so that the forces exerted by the muscles will tend to stabilize the denture rather than unseat it'.

Muscles involved in Neutral zone Techniques:

Muscles of Cheek:



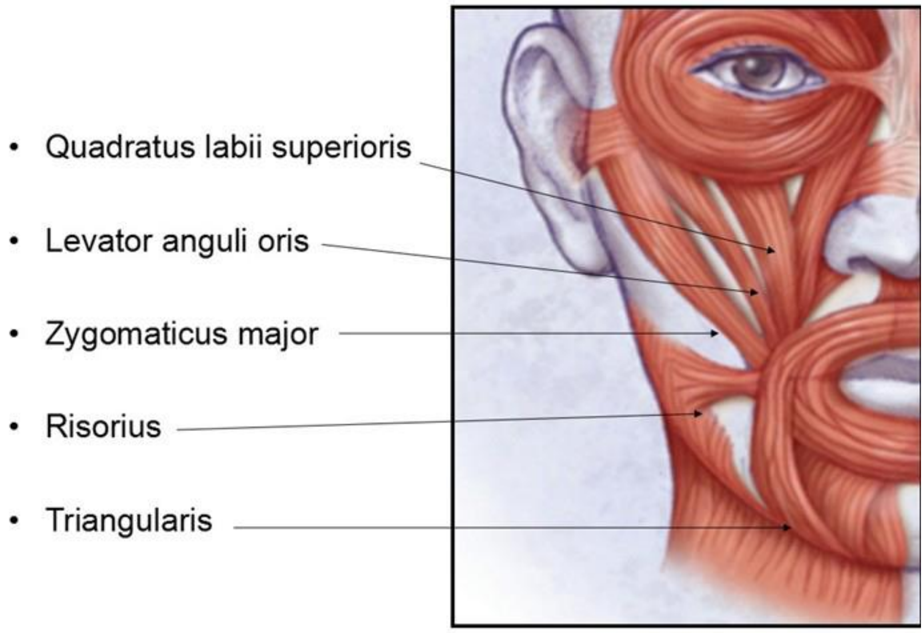
1. **Masseter:** Affects distobuccal border of mandibular denture.
2. **Buccinator:** Muscle fibres forms a continuous band; hence the size of the arch is limited by the strength of the contractile force and the length of the muscles when they are contracted.

Common practice of centralization or lingualization of occlusion creates a space between the cheek and teeth and external surface of the denture which prevents the buccinator from performing its proper function in two ways:

First: Food accumulation and becomes more difficult to the cheek to place the food back to the occlusal surface of the teeth.

Second: The space prevents the buccinator from neutralization the lateral forces of the tongue during function.

Muscles of the lips:

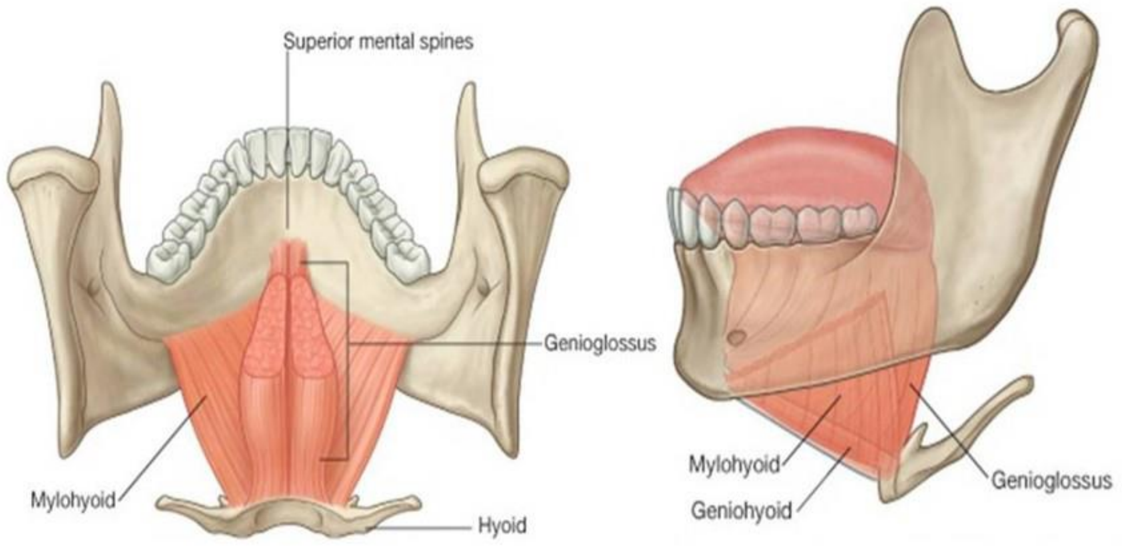


1. **Orbicularis oris:** During function as in chewing, smiling and swallowing, it exerts force against teeth and denture flanges which counteracted by the tongue.
2. **Caninus** This together with other muscles, pulls the upper lip upward and in sucking and swallowing pull the lip forward, thus exerting forces on teeth and labial flanges.
3. **Zygomatico major**: Pulls the angle of the mouth upward and backward.
4. **Risorius:** Retract the corner of the mouth.
5. **Mentalis:** Turns the lower lip outward and on contraction makes the lower labial vestibule shallow.
6. **Triangularis:** Contracts during sucking and exert pressure on teeth and denture flange.
7. **Modiolus:** It is contributed by followings facial muscles:

1. Orbicilaris oris
2. Buccinator
3. Levator anguli oris
4. Depressor anguli oris
5. Zygomaticus major
6. Risorius
7. Platysma
8. Levator labii superioris

Because of strength and variability of movement of the area, modiolus is very important in stability of lower denture. Proper positioning of teeth and contouring and narrowing of external surface of premolar area should be done otherwise the modiolus will constantly unseat the lower denture.

Muscles of the Tongue:



1. **Intrinsic muscles:**

   They are confined to the tongue and not attached to the bone. They produce change in shape of the tongue.

2. **Extrinsic muscles:**

These muscles attached to the bones and soft palate. They are:

Genioglossus, styloglossus, **hyoglossus** and **palatoglossus**.

They are responsible for tongue movement and change in shape. Tongue is capable of changing shape and position during function as in mastication, swallowing and speech. During function it will be in constant contact with lingual surface of lower teeth, lingual flange of lower denture and palatal surface of upper denture. The common practice of lingualization is one of the greatest influencing factors of lower denture instability because it violates the neutral zone and encroaches on the tongue space.

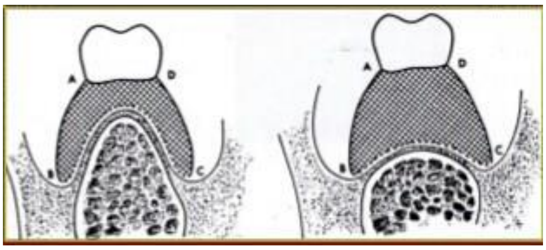
Influence of muscles on dental arches:

During childhood, the teeth erupt under the influence of muscular environment created by forces exerted by tongue, cheeks and lips, in addition to genetic factor.

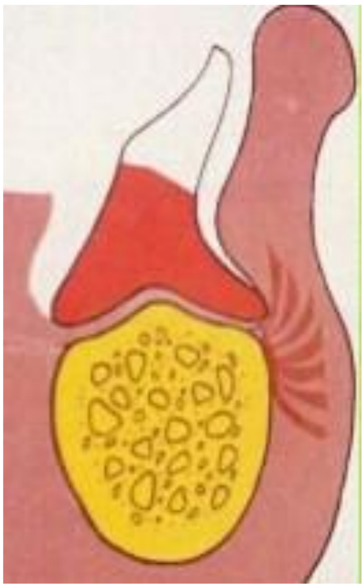
These forces have a definite influence upon the position of the erupted teeth, arch form, and occlusion.

Generally, muscular activity and habits which develop during childhood continue throughout life and after teeth loss.

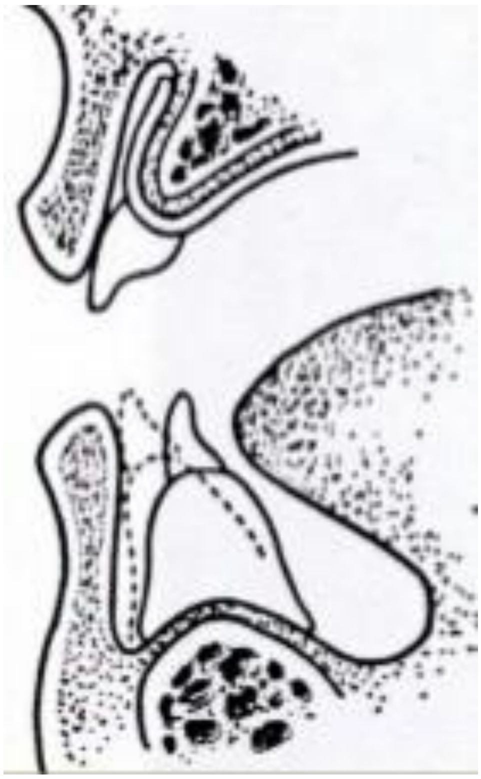
It is important to position artificial teeth in the arch form compatible with these muscular forces. As the impression surface area decreases (due to alveolar ridge resorption), the retention and stability of the denture decrease.



Consequently, retention and stability become more dependent on the correct positioning of the teeth and contours of the polished surfaces of the dentures.



The polished surfaces should be so contoured that the horizontally directed forces applied by the peridenture muscles should act to seat the denture. The artificial teeth should not be placed on the crest of the ridge or buccally or lingually to it rather these should be placed as dictated by musculature.



after the teeth have been lost, muscle function greatly influences any complete dentures that are placed in the mouth. It is therefore, extremely important that the teeth be placed in the mouth within the arch form that falls within the area that is compatible with muscular forces.

Influence of forces on denture surfaces:

The more ridge loss, the less influence of impression surface of the denture on its stability and retention, and the more external surface area which is needed to be contoured properly to overcome this situation.

The forces on external surfaces are changing in magnitude and direction during function and remain constant at rest.

In order to construct denture that function properly, we must develop fit and contour of external surface as fit and contour of impression and occlusal surfaces.

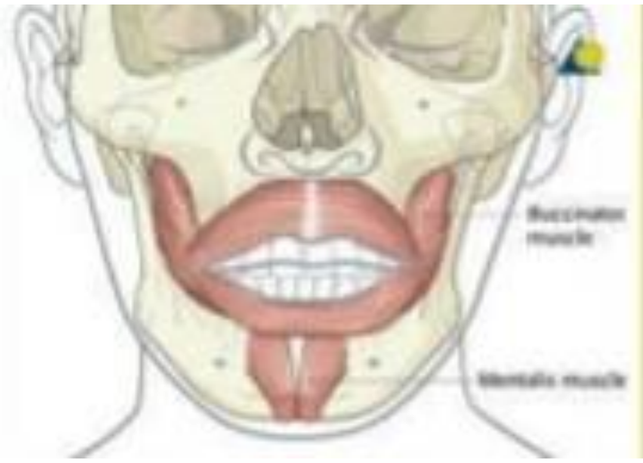
Objectives of Neutral zone Techniques:

1. Rehabilitation of complete denture patient.
2. Achieve maximum prosthesis stability, comfort, and function.
3. Arrange the denture teeth and contour the complete denture polished surfaces.
4. Minimize the ongoing diminution of the residual alveolar ridges.

Indications of Neutral zone Techniques:

1. Severely atrophic mandibular ridge.

2. High mentalis attachment



3. Neuromuscular disease.
4. Atypical shape of oral structures.
5. Trauma.
6. Systemic disease.
7. Locate optimal position for implants.

8. Partial glossectomy.
9. Motor nerve damage to the tongue.

Neutral zone technique could be performed in:

- Impression stage.
- Jaw relation record.
- Trial denture.

- Finished or previous prosthesis.

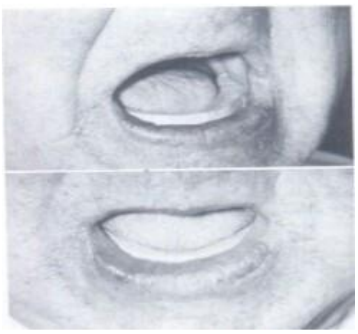
Recording neutral zone in final impression stage:

Step by step:

- Primary impression of upper and lower arches.
- Construction of acrylic bases. An acrylic denture base with retentive wires is fabricated to retain impression material during recording neutral zone area.

- Impression compound is adapted on external surface of the tray and inserted in the patient's mouth.

- Establishment of occlusal plane.



- Locating neutral zone for the upper arch.

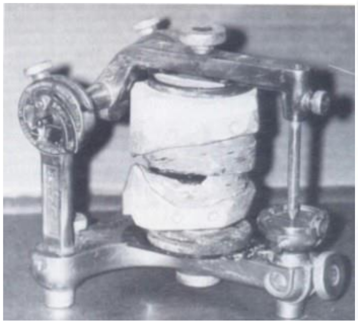
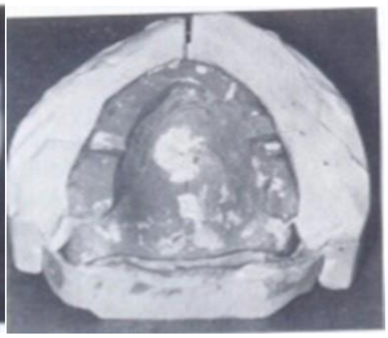
- Vertical dimension establishment.
- Lower final impression with Z.O.E.

The lower record base is inserted with lubricated upper denture base together to make impression with **closed mouth technique**.

- Second impression is made with **krex material** (*Krex® Z.O.E. Impression Corrective Paste is a zinc oxide eugenol impression paste that can be used for full denture impressions in a custom tray or as a wash*) which is white, soft, thin, free flowing and contrasting colour with the Z.O.E.

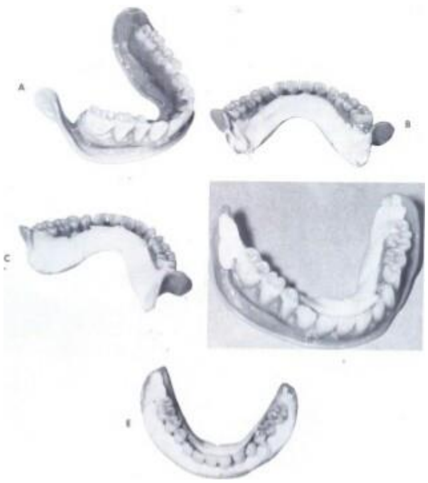
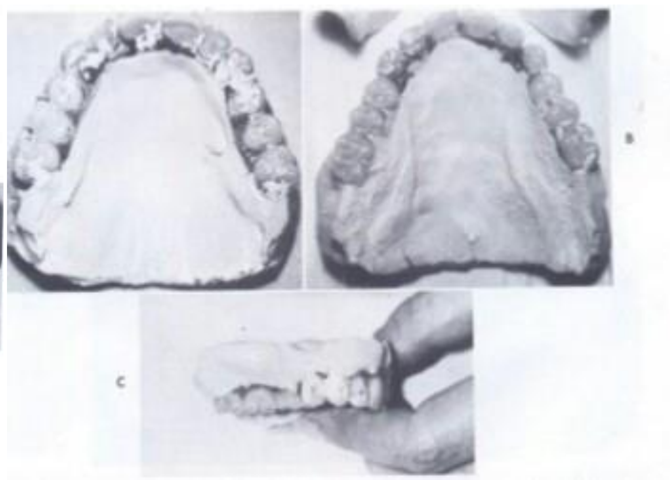
Upper arch impression:

- Several holes are made in the rugae area to allow excess Z.O.E. to escape during impression.
- Second impression with krex.
- Centric relation record.
- Mounting to the articulator and fabrication of matrices.



- Teeth arrangement.

- Trial denture and neutral zone impression for polished surfaces and the dentures is ready for investing.



Recording neutral zone in jaw relation visit:

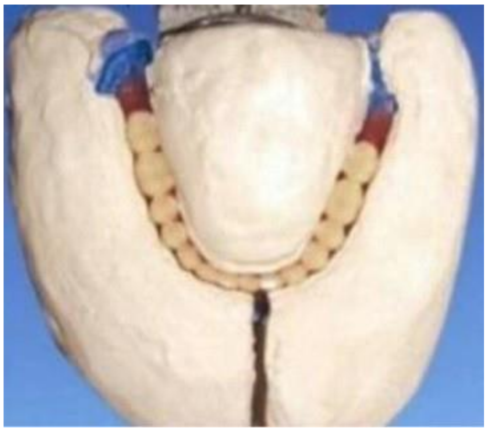
- Primary impression with impression compound.
- Final impression with Z.O.E.
- Jaw relation record.
- Lower acrylic special tray with metal spurs.
- Occlusal pillars built in green stick to establish the occlusal height.

- Instruct the patient to perform certain oral movement including: *sucking, grinning, whistling, pursing of the lips and swallowing*.

- Tissue conditioner being moulded with mouth movement.

- The tray is returned to the cast and plaster index is formed.

- Wax rim is formed and teeth set up.

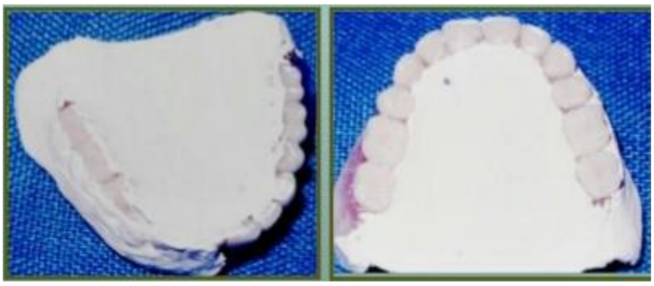


- Insertion

Recording neutral zone in try in stage:

- Apply **Vaseline** on trial denture before making impression.
- Impression material is applied on buccal & lingual surfaces of waxed up denture.

- Patient performs oral function.
- Inspect the impression on polished area including palatal surface.



- Carefully carve the material over tooth surfaces with carver.

- Finished denture.

Recording neutral zone in finished denture:

- Determining the fit of complete denture to neutral zone.
- Coat the polished surface of the denture with low viscosity silicone impression material.
- Ask the patient to perform functional movement while the material sets.
- Inspect the denture and adjust any heavy muscle contact.

- Determining the optimal space for a segment of the denture.
- Remove the teeth and base material from the segment of the denture that needs modification.
- Apply adhesive and take the impression with mouldable material.
- Check for stability and undertake the laboratory procedure.

Comparison between conventional mandibular denture and mandibular denture made by neutral zone concept

- According to setting of the teeth in relation to the crest:

Position	Conventional method	Neutral zone method
Anterior	Slightly labial	Slightly lingual
Premolar area	Exactly on the crest	Slightly lingual
Posteriorly	Lingually	buccally

- According to denture surface area:

The neutral zone denture tissue surface area is higher than the conventional denture.

- According to denture volume:

The neutral zone denture volume is lower than the volume of the conventional denture.

Advantages:

1. Improved stability and retention.
2. Correct positioning of posterior teeth allowing sufficient tongue space.
3. Reduced food trapping adjacent to the molar teeth.
4. Good aesthetic due to facial support.

Limitation for the success of neutral zone impression technique:

1. Viscosity of the material used. More viscous, the more difficult for the muscle to mould.
2. Geriatric patients could suffer from the procedure due to loss of their muscular tone.
3. Proper stability & retention of the bases, so as the comfort.

4. The resultant neutral zone is often narrow and might be lingually placed, this will affect functional movement of the tongue and phonetics.
5. The technique does not offer any guidelines for the selection of teeth.

Neutral zone always moves according to the periods of edentulism, tonicity of the perioral musculatures and tongue. Arrangement of the teeth in neutral zone, increasing the impression surface area of the denture and reduction in the volume of the denture, provides good retention, stability and comfort to the patients.

Occlusion in complete denture

Lec.:1-2 **د. صفوان عبدالحميد**

Occlusion: the static relationship between the incising and masticating surfaces of the maxillary or mandibular teeth or tooth analogues.

Articulation: the contact relationship of maxillary and mandibular teeth as they move against each other.

Centric Relation (CR): a maxilla mandibular relationship, independent of tooth contact, in which the condyles articulate in the anterior-superior position against the posterior slopes of the articular eminences .it is a clinically useful, repeatable reference position. ***(Bone to bone)***

Centric Occlusion: the occlusion of opposing teeth when the mandible is in centric relation; this may or may not coincide with the maximal intercuspal position. ***(Tooth to tooth)***

Occlusal Balance: a condition in which there are simultaneous contacts of opposing teeth or tooth analogues on both sides of the opposing dental arches during eccentric movements within the functional range.

Occlusal Harmony: a condition in maximal intercuspal position and eccentric jaw relation in which there are no interceptive or deflective contacts of occluding surfaces.

Occlusal interference:

1. Any tooth contact that inhibits the remaining occluding surfaces from achieving stable and harmonious contacts;

2. Any undesirable occlusal contact.

Maximal intercuspal position the complete intercuspation of the opposing teeth, independent to condylar position.

Mandibular movement can be: opening closing, protrusive, and lateral in lateral it may be

- Working side is the side that the mandible moves toward it in lateral excursion.
- Nonworking side is the side that the mandible moves away from during lateral excursion.

	Natural teeth	Artificial teeth
1.	Fixed in bone	Rest on residual ridge
2.	Supported by periodontal ligament	not fixed to soft tissue
3.	Tooth move into socket during mastication because of elasticity of ligament	Denture move toward tissue because of resiliency of mucosa
4.	When teeth, move one side during mastication the other side is not affected	When teeth meet on one side, the other side loses balance upsetting retention and stability
5.	When teeth move in socket, they produce stretching effect and exert tensile force	Compression of soft tissue causes displacement of the supporting tissue
6.	Tensile force produce stimulation to under lying bone	Compression causes pressure on mucosa of affecting vascular supply of bone
7.	Physiologic stimulation maintains good health of the bone	Instability of denture causes loss of bone because of leverage
8.	To maintain the stimulus optimal occlusion of natural teeth is important	To maintain the supporting tissue in good health, planed occlusion is necessary

Requirements of ideal complete denture occlusion:

1. Stability of denture in both centric and eccentric relation.
2. Balanced occlusal contact bilateral.
3. Cusp height reduced to control horizontal force.
4. Cutting, penetrating and shearing efficiency of occlusal surface.
5. Incisal clearance during posterior function like chewing.
6. Unlocking (removing interference) of cusps mesiodistally.

Objectives of occlusion in complete denture

1. Preservation of the remaining tissues
2. Proper masticatory efficiency

3. Enhancement of denture stability, retention and support
4. Enhancement of phonetics and aesthetics

Requirement of Complete Denture Occlusion

1. Stability of occlusion in centric relation.
2. Balanced for all eccentric contacts bilaterally for all eccentric mandibular movements.
3. Unlocking the cusp mesiodistally to allow for gradual but inevitable settling of the bases due to tissue deformation and bone resorption.
4. Control of horizontal forces by buccoligual cusp height reduction according to the residual ridge resistance and interridge space.
5. Functional lever balance by favourable tooth to ridge crest position.
6. Cutting and shearing efficiency of the occlusal surface (sharp cusps or ridges).
7. Anterior clearance of teeth during mastication.
8. Minimum occlusal contact between the upper and lower teeth to reduce pressure during function (lingualized occlusion)

Types of occlusions

- Balance occlusion
- Lingualized occlusion
- Monoplane occlusion

• <u>Balance occlusion</u>

Balance occlusion in complete dentures can be defined as stable simultaneous contact of the opposing upper and lower teeth in centric relation position and a continuous smooth bilateral gliding from this position to any eccentric position within the normal range of mandibular function.

In lateral excursion: (working side)

- ***Anterior teeth-*** the maxillary & mandibular anterior teeth contact on the working side.

- ***Posterior teeth*-** the buccal & lingual cusps of the maxillary & mandibular posterior teeth are in contact. If lingualized occlusion, the maxillary lingual cusp will be in contact with the mandibular lingual cusp.

In lateral excursion: balancing side

- ***Anterior teeth*-** the maxillary & mandibular anterior teeth may contact on the balancing side.
- ***Posterior teeth*-** the lingual cusps of the maxillary teeth will be in contact with the buccal cusps of the mandibular teeth. With monoplane balanced occlusion, usually only the second molars are in contact or the balancing ramp.

Advantages of Balance occlusion

1. Distribution of load
2. Stability
3. Reduced trauma
4. Functional movement
5. Efficiency
6. Comfort

Factors affecting the balanced occlusion (Laws of Articulation Hanau quint)

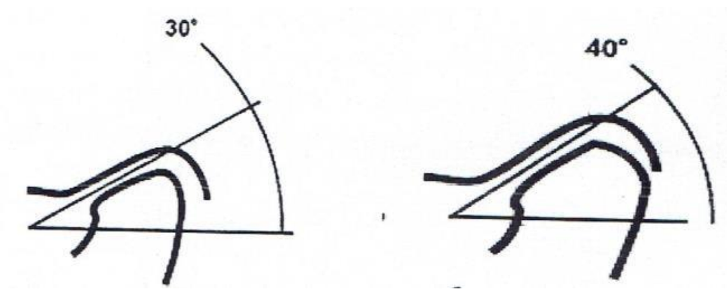
1. Condylar guidance
2. Incisal guidance
3. The occlusal plane
4. The compensatory curves
5. Cusp angulation

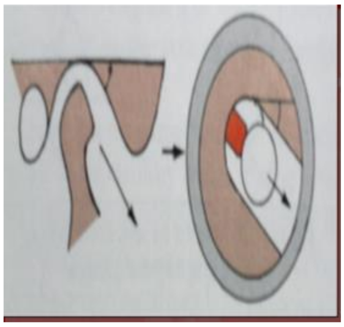
Inter relation between these factors may be described by Thielman's formula

$$\boldsymbol{Balanced\ occlusion} = \frac{\boldsymbol{condylar\ inclination} * \boldsymbol{Incisal\ guidance}}{\boldsymbol{Occlusal\ plane} * \boldsymbol{compansatory\ curve} * \boldsymbol{cusps\ angulation}}$$

1. Condylar guidance

The angle formed by an imaginary horizontal line at the superior head of the condyle and the path that the condyle will pass through during function. It varies from individual to individual because of anatomical differences. About 33^{o}





Definitions

- **Condylar guidance:** mandibular guidance generated by the condyle and articular disc traversing the contour of the articular eminence.
- **Condylar guidance:** the mechanical form located in the posterior region of an articulator that controls movement of its mobile member.

The first factor of occlusion is the condylar guidance, this factor recorded from thenpatient so it is fixed factor cannot be modified by the dentist.

2. Incisal guidance:

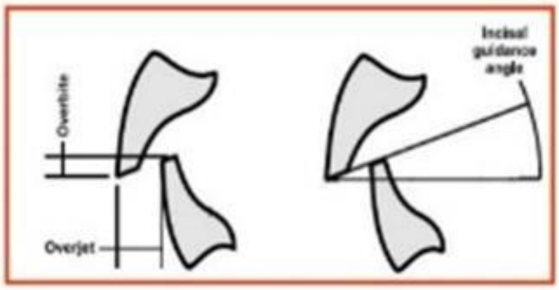
- **Incisal guidance:** the influence of the contacting surfaces of the mandibular and maxillary anterior teeth on mandibular movements.

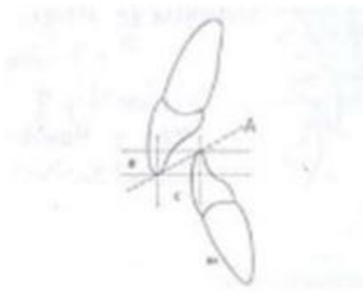
It is usually expressed in degrees of angulation from the horizontal by a line drawn in the sagittal plane between the incisal edges of the upper and lower incisor teeth when closed in centric occlusion.

- **Incisal guidance:** the influences of the contacting surfaces of the guide pin and guide table on articulator movements.

Incisal guidance depends on the:

1. Desired over jet.
2. Over bite.





- This angle varies directly with the vertical overbite and inversely with the horizontal over jet.
- This angle is set to 10° in CD and not exceeding 20°
- This angle determined by aesthetic, phonetic, ridge relation, inter-alveolar distance, this means it is under the control of the dentist,

3. Plane of occlusion:

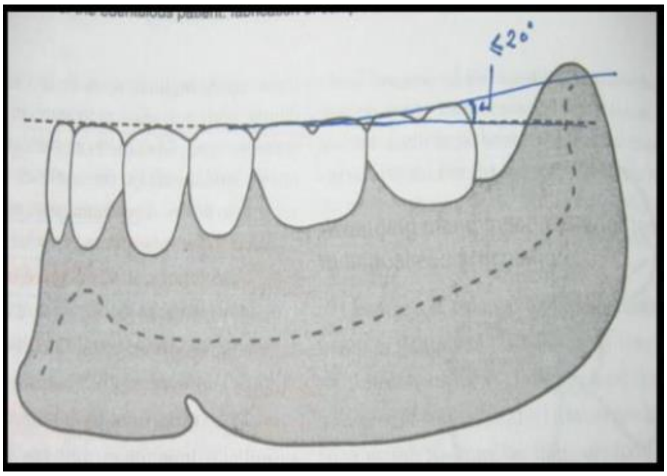
a. It is imaginary surface related anatomically to the cranium and theoretically touches the incisal edge of incisors and the tip of occluding surface of posterior teeth.

b. Maxillary occlusal plane should parallel to interpapillary line, posteriorly usually parallel to the ala-tragus line.

c. In the mandible established anteriorly by the cusp height of lower canine near the commissure of the mouth(corner) and posteriorly by the retromolar pad.

4. The compensating curve: the arc introduced in the construction of complete removable dental prostheses to compensate for the opening influences produced by the condylar and incisal guidance's during lateral and protrusive mandibular eccentric movements.

- The compensating curve incorporated in a properly oriented plane of occlusion
- Compensating curve in artificial dentition is anteroposterior curve



Anteroposterior compensating curves

5. **Cuspal angulations**: or inclination of cusp less artificial teeth

It depends on several factors residual ridge, neuromuscular control, aesthetics, etc.) however, it's better to reduce the cuspal inclination to help reduce horizontal forces of occlusion.

Interaction of the five factors:

Two of the four can be controlled (the incisal guidance and the plane of occlusion) can be altered only a slight amount because of aesthetic and physiologic factors. The important working factors for the dentist to manipulate are the compensating curve and the inclinations or cusp on the occlusal surfaces of the teeth. (***For the balanced occlusion, it is important to use adjustable articulator***).

How to record the condylar guidance?

After recording of jaw relation (orientation relation, vertical, centric jaw relation) then a protrusive record should be made, inorder to set the condylar guidance on articulator according to the following steps:

1. place V shape notch.
2. allow the patient protrude a minimum of **5-6mm**, but less than **12mm**
3. place elastomeric registration material between occlusal rim while the patient close in protrude position.
4. after complete setting of material. record base and registration are removed, place on articulator.

5. on the articulator the condylar element release from hinge position, instrument protrude, they record approximated. The condyle elements are rotated until there is maximum interdigitating of the registration and opposing occlusal rim.

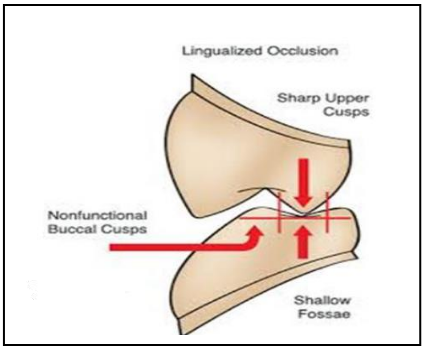
- **Lingualized occlusion:**

It involves use of large upper palatal cusp against wide shallow lower central fossa.

-The buccal cusps of upper and lower teeth do not contact each other.

-The maxillary palatal cusp tip should contact opposite mandibular central fossa.

-The cusp incline of mandibular teeth relatively flat result in less lateral force and displacement during function.



Indication:

1. High aesthetic needed.
2. Weak muscle of mastication.
3. Displaceable supporting tissue.
4. Sever alveolar bone resorption.
5. Discrepancy in jaws size. Narrow upper arch and wide lower arch.
6. implant supported over denture.
7. Previous successful denture with lingualized occlusion.

Advantages:

1. Simpler technique. Less precise CR records.
2. Aesthetics.
3. Better penetration of the food bolus.
4. easer to adjust occlusion.
5. it may be used in Cl. II, Cl. III and cross bite.
6. Centralization of vertical forces.
7. Minimizing tipping force.
8. Potentially of bilateral balance.

Disadvantages:

1. Difficulty in obtaining repeatable centric record (incoordination, jaw malrelation)
2. Severe ridge resorption (lateral forces displace the denture) may more easily be handled with a monoplane scheme

- **<u>Monoplane occlusion or (neutrocentric):</u>**

1. Flat occlusal plane set with non-anatomic teeth.
2. The antero-posterior occlusal plane parallel to the denture foundation area.
3. There is no vertical overlap of anterior teeth.
4. Tooth Contact should occur only when mandible in centric relation.
5. Opposing artificial teeth should not contact when jaws in eccentric relation.
6. In protrusion there is disclosure of posterior teeth as a result of arrangement in single plane, the patient is instructed not to incise the bolus
7. There is no curve of spee or curve of Wilson (compensating curves).

Indications:

1. Jaw size discrepancies CI. II, Cl. III, malocclusion and cross bite.
2. Uncoordinated jaw movement.
3. Mostly for geriatric patients.
4. minimal ridge, resorbed ridge, it reduces horizontal forces implant may help.

Advantages:

1. Simple technique and less time consuming.
2. Less precise jaw relation records.
3. Lateral forces are reduced by eliminating cuspal inclines.
4. Simpler and easier occlusal adjustments.
5. Occlusion is not locked.

Disadvantages:

1. Least aesthetic.
2. Poor bolus penetration.
3. Cannot be balanced in eccentric excursions.

Types of Occlusal Scheme:

1. Anatomic teeth:

Simulate the natural teeth form with inclination approximately 33°

Advantages:

1. Aesthetic.
2. Better food penetration.
3. Vertical stress decrease.
4. Harmony with TMJ and muscle of mastication.
5. Balance occlusion in eccentric position

***Disadvantages*:**

1. Precise technique requires.
2. More time.
3. Difficult teeth position in Cl. II & Cl. III
4. Greater lateral force.

2. Semi anatomic teeth

Cusp incline less steep than anatomical teeth called modified anatomical teeth (Less than33°)

Advantages:

1. Aesthetic.
2. Good chewing efficacy.
3. Less lateral force.
4. Balance occlusion.

Disadvantages

1. least aesthetic.

2. poor bolus penetration.
3. cannot be balanced in eccentric excursions

3. Non anatomical teeth (Flat and without cusp height):

Advantages:

1. Used for patient with poor neuromuscular coordination.
2. Used for patient with malrelation jaws.
3. Used for patient with cross bite or Cl.III.
4. More comfortable.
5. Less time required in set up.
6. slightly more aesthetic than neutrocentric occlusion.

Disadvantages:

1. Use of compensatory curve may cause the same damaging effects as cuspal inclines.
2. Occlusal adjustment is more difficult to accomplish

Balance occlusion for non-anatomic teeth may be accomplish by:

- ***Compensatory Curve.***
- ***Tilting the second molar.***
- ***Placing the balancing ramps.***

Factors influencing the selection of selection of occlusal scheme:

1. **Characteristics of occlusal scheme:**

- Tooth form and arrangement
- Balanced or not

2. Characteristics of the patient:

- Height and width of the residual ridge
- Aesthetic demands of the patient
- Skeletal relations
- Neuromuscular control
- Tendency for parafunctional activity

Post-insertion problems in complete dentures

Lec:5 **Dr. Safwan A. Suliman**

Fabrication of complete dentures is dependent on the psychological and biological interplay between the patient and the dentist. To date removable dentures play an important role in the majority of the people of our country and thus one of the irreplaceable treatment options, because not every patient is financially sound that he/she will go for implants. The basic necessity of the patient for a complete denture is mastication, aesthetics, phonetics and comfort while using the removable prosthesis. Although the complete dentures are very much compatible with the oral structures, this requires a little bit of time for tissue conditioning. Different authors classified the "post-insertion denture problems".

Post-insertion denture problems:

1. Looseness or instability
2. Lower rises when the mouth is opened
3. Sore spots
4. Gagging
5. Feeling of space in an upper denture
6. Phonetic problems
7. Can't eat most foods/ masticatory insufficiency
8. Loss of taste
9. Clicking while eating or talking
10. Tenderness when swallowing
11. Food under dentures
12. Saliva under dentures
13. Dislodgement when drinking

14. Drooling at corners of mouth

15. Excessive bulk

16. Cheek, lip, or tongue biting

17. Halitosis

18. Dry mouth (Xerostomia)

19. Excessive salivation

20. Peculiar tastes

21.TMJ problems

22. Burning sensation

- **Problems associated with maxillary dentures:**

1. **Maxillary denture dislodges, while performing some function**, due to:

a. Extension in the hamular notch area.

b. Inadequate relief to the frenum attachment.

c. Excessive thick denture bases over the distobuccal alveolar tubercle area leaving insufficient space for the forward and medial movement of the anterior border of the coronoid process.

d. When the anterior maxillary teeth are placed very far in the anterior direction.

e. When the maxillary posterior teeth are placed very far in the buccal direction.

f. Placement of posterior palatal seal very far in the superior direction, which results in displacement of soft tissue, which results in dislodgement of the maxillary denture.

g. Occlusal disharmony.

2. **Dislodgement of maxillary denture, when jaws are at rest:**

   a. Underfilled buccal vestibule.

   b. No border seal present.

   c. Excessive formation of saliva.

d. Xerostomia.

The consistency of saliva is usually involved when the maxillary denture slowly loses its retention and if contraction occurs at the modiolus, dislodgement of the denture occurs, if the flanges of the denture are not contoured properly.

3. Upper drops while talking or laughing:

- **a.** Inadequate posterior palatal seal
- **b.** Poor peripheral seal
- **c.** Occlusion not balanced

4. Upper tips on incisal pressure:

a. Pendulous tissue presents over the ridge

b. Insufficient posterior palatal seal present or short posterior border

- **Problems associated with mandibular dentures:**

1. Dislodgement during function

a. Extending in the lateral direction beyond the external oblique line

b. Overextension of the lingual flange.

c. Placing the occlusal plane too high, causes dislodgement when the tongue tries to handle the bolus of food.

d. Improper contour of the polished surface.

2. Lower denture unseated during moderate tongue movements:

a. Poor border seal.

b. Lingual flange over-extended.

c. Clearance for lingual frenum.

d. Occlusion not balanced.

- **Sore spots:**

One of the most common complaints is usually associated with the use of new dentures. This occurs due to:

1. Inadequate coverage of the edentulous ridge with the denture.
2. Over-extended flanges in the vestibular region.
3. Excessive vertical dimension of occlusion, results in overall redness on the edentulous ridge.
4. Presence of sharp bony projections, from the edentulous ridge.
5. Presence of thin atrophic mucosa over the edentulous ridge.
6. In case tori is present either in the maxillary or in the mandibular region and is unrelieved.
7. Unfavourable patient habits like clenching of teeth, if the patient is a heavy bruxer, tobacco chewer.
8. Local infection bacterial or fungal.

Treatment modality will stick to the underlying cause i.e., the denture base should cover the entire edentulous ridge, over-extension of the denture base should be reduced and should be smooth, adequate vertical dimension not excessive, sharp bony projections should be smoothened, tori should be relieved, local infection should be treated with appropriate medicine, started with discontinuing to wear the denture for at least 24 – 48 hours.

- **Gagging**

Gagging can be classified into two types:

1. **Psychogenic**: which starts in the patient's mind itself, without any initiation and is very difficult to treat.
2. **Somatogenic:** it has its initiation from the body i.e., denture or any dental procedure, and it can be treatable.
3. **Dental reason:** over-extended denture base in posterior palatal seal area, poor occlusion, lack of retention, excessive vertical dimension.

Treatment:

1. Determination of the cause when possible.
2. Remove all biological and mechanical factors that may contribute to the problem.
3. Prescribe a combination of hyoscine, hyoscyamine and atropine with a sedative during the initial period of denture use.
4. Acupressure.
5. Consider referring the patient for psychiatric help.

- **Feeling of space under the maxillary denture**

This might be due to shrinkage of the denture resin, due to processing error and if there is any history of anterior traumatic occlusion, which results in paraesthesia of the nasopalatine nerve.

- **Problems related to phonetics**

When a patient is having problems speaking, may be a result of excessive vertical dimension of occlusion, too narrow air space on the anterior part of the palate, too broad air space on the anterior part of the palate, when upper anterior teeth placed too far lingually, when there is insufficient support to the lips provided, when there is improper vertical positioning of maxillary anterior teeth, when maxillary anterior set too long or too far down, when maxillary anterior set too short or too high up, when there is improper anteroposterior positioning of maxillary anterior teeth.

Treatment

Increase the passage of air (slowly) by removing some of the resin in increments behind the anterior teeth. If there is no improvement, try flowing some red carding wax in 1 mm increments, over the anterior and lateral palate to insure tongue contact.

If the air channel is blocked there may be a "shushing" or lisping sound. This may be due to an excessive V.D.O.

Solution

Before considering a remake at a reduced V.D.O., increase the size of the channel by thinning the anterior portion of the palate.

- **Inability to eat food**

Some of the edentulous patients come with a problem, that they are not been able to eat food with their complete dentures. This could be due to poor muscular control, which could be the one reason that the patient wasn’t able to chew/masticate the food. Another reason could be that the patient's expectations

were too high with the prosthesis delivered, that he/she wants to eat every food that once they enjoyed when they had natural teeth.

Treatment

1. Psychological boost up to the patient.
2. Dentists can change the occlusal scheme, and can go for lingualized occlusion.
3. Can use lingual bladed teeth.

- **Taste loss**

Due to the atrophy of taste buds in old age, patients might suffer from taste loss sensation. In most of the cases, it is psychological.

- **Clicking sound while eating food**

1. Over-extended complete denture.
2. Premature contacts.
3. Excessive vertical dimension of occlusion

Treatment

1. Clinical remount should be done, with occlusal equilibration.
2. Relining or rebasing, in case the fit of the denture is not appropriate.

- **Pain during swallowing**

Mostly due to overextended disto-lingual complete denture flange. This over-extension produces a slight to moderate sensation of pain during swallowing. It should be corrected by reducing the overextended denture flange with the use of a disclosing agent and after that smoothened the denture flange.

- **Drooling of saliva at the corner of the mouth:**

1. Usually seen in patients with poor muscular control.
2. When there is a closed vertical dimension of occlusion.
3. In cases of hypersalivation.

The treatment modality should be to treat the underlying cause, if this occurs due to a decreased vertical dimension of occlusion, a new denture should be made with the correct vertical dimension and another attempt should be made to control the drooling of saliva at the corner of the mouth by making the denture flange a bit thicker at the modiolus area.

- **Cheek biting, lip biting or tongue biting:**

The most common cause of cheek biting is to presence of inadequate overjet between the maxillary and mandibular anterior teeth. It can be corrected by increasing the over jet by reducing the buccal surface of lower posterior teeth. Cheek biting is also due to loss of vertical dimension, because of these cheeks tend to occlude between the occlusal surface of the denture. Tongue biting can be treated by reducing the palatal surface of maxillary posterior teeth, mostly the maxillary molars. Lip biting is mostly due to poor neuromuscular control in old patients.

- **Halitosis:**

Usually associated with bad oral hygiene when the patient is not cleaning his/her denture for a long period may lead to bad breath or it may be due to a medically compromised condition.

- **Xerostomia:**

Most elderly patients are on multiple medications for systemic diseases, and many of these drugs are capable of causing "**xerostomia**", which has adverse effects on the tolerability of complete dentures. These types of patients have problems/difficulties in masticating, and swallowing food.

These patients are advised to drink water in between the meals and should have plenty intake of water or water substitutes. The use of artificial saliva or mouth rinses may be helpful to patients suffering from the condition of xerostomia. One can also use a reservoir at the palatal side which is filled with artificial saliva, surely overcoming the quality of life of xerostomic patients.

Sialagogues are the drug of choice in treating patients suffering from dry mouth conditions, they stimulate the flow of saliva without affecting its ptyalin content. The main causes of dry mouth condition in old age patients are some drugs such as antidepressants, geriatric degeneration, deficiency of vitamin A, chronic renal disease, and psychic tension.

- **Excessive salivation:**

In most cases, when the patient starts wearing denture for the very first time, reports a problem of excessive salivation and this problem resolves with time as the oral structures become habitual to the denture. And secondly due to psychological tension.

- **Temporomandibular jaw problems:**

They occur mostly due to spasms of muscles of mastication, or injury to the muscles or the surrounding structure. These types of problems are usually seen in patients who were long-term wearers of complete dentures, that too with much amount of loss of vertical dimension of occlusion. If this problem is not treated at time will lead to some other serious complications like referred pain to ear, TMJ, muscles of mastication, clicking sound in TMJ or crepitus, tinnitus in ear, pain during opening or closing of the jaw, midline deviation/shift during opening.

Treatment:

Primary goal of treatment is to treat the underlying cause of the problem. If related to vertical dimension, new set of complete dentures with correct vertical dimension should be made again, patient should remain on soft diet for a specific time period, hot packs are advised over the area where the pain is persistent, and muscle relaxants should be advised to the patient.

- **Burning sensation**

Most commonly due to ill fitted denture, poor denture occlusion, due to menopause in females. Treatment modality will stick to the underlying cause, patient is advised **not** to wear the denture for 2-5 days at least, do warm saline rinses two to three times a day, application of oral medication in case of candida infection or a new set of complete dentures are advised after the infection subsides. And if the burning sensation is due to compression of nerve, oral surgical procedure is required.

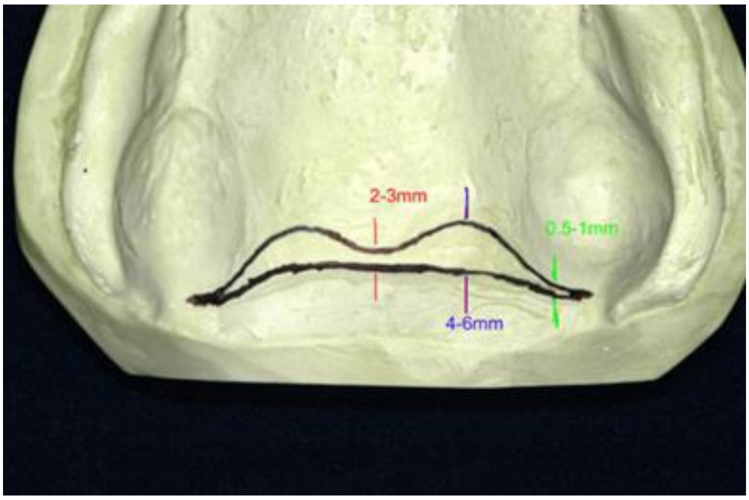
Posterior Palatal seal

Lec. 13 **Dr. Safwan A. Sulaiman**

Complete dentures may suffer from a lack of proper border extension, but most important of all is the **posterior palatal extension** on maxillary complete dentures. The posterior border terminates on a surface that is movable in varying degrees and not at a turn of tissue as are the other denture borders. Locating and designing of posterior palatal seal after thorough understanding of the anatomic and physiological boundaries of this dynamic region greatly enhances border seal and increases maxillary complete denture retention.

Hundreds of dentures have failed due to the improper establishment of the distal limit and to an improper posterior palatal seal. Its location and preparation on the master cast are often done by the dentist or dental technician without reference to anatomical landmarks of the mouth.

Posterior palatal seal area: The soft tissue area **limited posteriorly** by the distal demarcation of the movable and non-movable tissues of the soft palate and **anteriorly** by the junction of the hard and soft palates on which pressure, within physiologic limits, can be placed; this seal can be applied by a removable complete denture to aid in its retention.



Functions of the Posterior Palatal Seal (PPS**):**

The **primary function** is that of **completing the peripheral seal** and **enhancing the retention of complete denture**. The other purposes served by the PPS are as follows:

1. Maintains contact of denture with soft tissue during functional movements of stomatognathic system, by which decreases gag reflex.
2. Decreases food accumulation with adequate tissue compressibility.
3. Decrease patient discomfort of tongue with posterior part of denture.
4. Compensation of volumetric shrinkage that occurs during the polymerization of PMMA
5. Increases retention and stability by creating partial vacuum.
6. Increased strength of maxillary denture base.
7. Adds confidence and comfort to the patient by enhancing retention.

The peripheral seal of maxillary denture is an area of contact between the mucosa and peripheral polished surface of the denture base, the seal prevents passage of air between denture and tissue.

Retention of a denture is achieved from adhesion, cohesion & interfacial surface tension that resist the dislodging forces that act perpendicular to the denture base.

The posterior palatal seal is placed in the maxillary complete denture because the acrylic will distort slightly and pull away from the posterior palatal area of the maxillary cast. The acrylic will shrink toward the areas of greatest bulk, which are the areas over the ridge where the teeth are placed. The posterior palatal seal provides a vacuum seal between the denture and the soft palate that holds the maxillary complete denture securely in place.

The adequate PPS resist the horizontal and lateral forces acting on maxillary denture base as the denture border terminate on soft resilient tissue and there by maintain a proper denture seal.

A well-fitting and retentive complete denture requires a well-fitting tissue surface, a peripheral border compatible with the muscles and tissues which make up the mucobuccal and mucolabial spaces so that a peripheral seal is created by the soft tissue draping over them. It is usually obtained by labial and buccal seal. In the posterior region, it is mainly by the posterior palatal seal. At the posterior extension of the maxillary denture, where the tissues are less compliant, special attention is required to make the seal effective.

Anatomical Considerations for Posterior Palatal Seal

The PPS is divided in *two anatomic* separate boundaries:

1. Post palatal seal.
2. Pterygomaxillary seal.

The *post palatal seal* is *extending from one tuberosity to the other*. *Pterygomaxillary seal* extend through *pterygo maxillary notch continuing for 3-4 mm anterolaterally approximation the mucogingival junction*. It also occupies the entire width of pterygomaxillary notch.

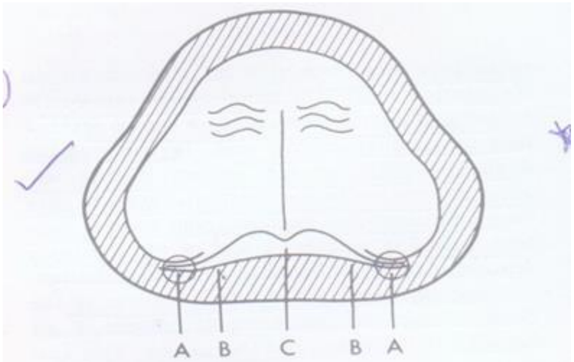


Figure 8-1 (A) Pterygomaxillary seal extends through the pterygomaxillary notch. (B) Postpalatal seal extends medially from one tuberosity to the other. (C) Posterior palatal seal area lies between the anterior and posterior vibrating lines.

The notch is covered by pterygomaxillary fold (extend from posterior aspect of tuberosity to retromolar pad). This fold influences the posterior border seal if mouth is wide open during final impression procedure.

Fovea palatina are two glandular opening within the tissue posterior of hard palate lying on the either side of midline.

• Fovea palatina should be used only as a guideline for the placement of posterior palatal seal.

Medial palatal raphe which overlies medial palatal suture contain little or no submucosa and will tolerate little or no compression. The seal area narrows down in the midpalatine area due to the scarcity of connective tissue and the prominence of posterior nasal spine. Frequently formed at the junction of the aponeurosis and the posterior nasal spine is a narrow bundle similar to a ligament. The posterior palatal seal is not placed over this narrow area. If the tourus palatini extend to the bony limit of the palate leaving little or no room to place the PPS then its removal is indicated.

Physiological consideration:

Saliva:

Presence of thick ropy saliva can create hydrostatic pressure in the area anterior to the posterior palatal seal, resulting in a downward dislodging force.

Vibrating line:

An imaginary line across the posterior part of the soft palate marking the division between the movable and immovable tissues; this line can be identified when the movable tissues are functioning.

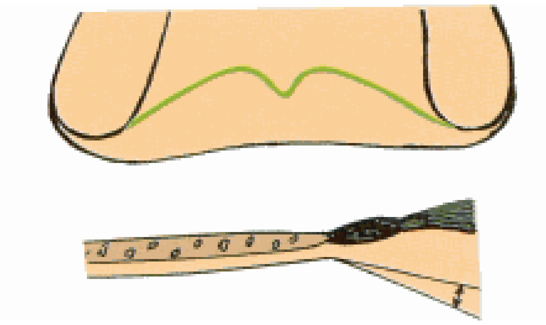
1. Anterior vibrating line.
2. Posterior vibrating line.

Anterior vibrating line:

It is an imaginary line lying at the junction between the immovable tissues over the hard palate and the slightly movable tissue of the soft palate.

Methods of location of anterior vibrating line (AVL):

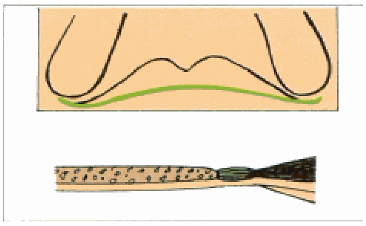
Instructing the patient to say “AH” with short vigorous bursts due to projection of the posterior nasal spine. The anterior vibrating line is not a straight line between both hamular processes. The AVL is cupids bow shaped.



Anterior vibrating line

Posterior vibrating line (PVL):

It is an imaginary line at the junction of the aponeurosis of the tensor veli palatine muscle and the muscular portion of the soft palate visualized, while the patient is instructed to say ‘ah’ in short bursts in a normal unexaggerated fashion. It represents demarcation between the part of soft palate that has limited or shallow movement during function and the remainder of the soft palate that is markedly displaced during functional movement. The posterior vibrating line marks the most distal extension of the denture base.



Posterior vibrating line

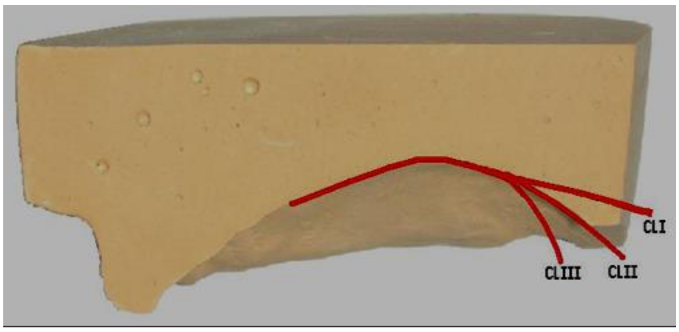
Classification of soft palate:

According to House classification:

Class I: It indicate soft palate that is rather horizontal as extend posteriorly with minimum muscular activity. There is considerable separation between anterior and posterior vibrating line, does having wide PPS area yielding more retentive denture base.

Class II: The soft palate gradually slopes from the hard palate. Overextension of the posterior limit of the denture can be tolerated to some extent. Palatal contour lies between class I and class III.

Class III: it is seen in conjugation with high V shape palatal vault. There is few mm separation of anterior and posterior vibrating line thus there is small PPS area and less retention. The soft palate abruptly slopes from the hard palate. Hence, the posterior limit of maxillary denture remains very critical.



Class I – easiest to tolerate, broadest range, hardest to locate.

Class II – most common

Class III – easiest to locate, hardest to tolerate

Designs of the posterior palatal seal:

Winland and Young surveyed the commonly employed posterior palatal seal designs and summarized them as follows:

1. A bead posterior palatal seal

2. A double bead posterior palatal seal
3. A butterfly posterior palatal seal
4. A butterfly posterior palatal seal with a bead on the posterior limit
5. A butterfly posterior palatal seal with the hamular notch area cut to half the depth of a no. 9 bur
6. A posterior palatal seal constructed in reference to House's classification of palatal forms:

Class I: A butterfly shaped posterior palatal seal with3-4 mm wide.

Class II: Posterior palatal seal is narrow with 2-3 mm of width.

Class III: A single beading made on the posterior vibrating line.

Methods or techniques of recording posterior palatal Seal area

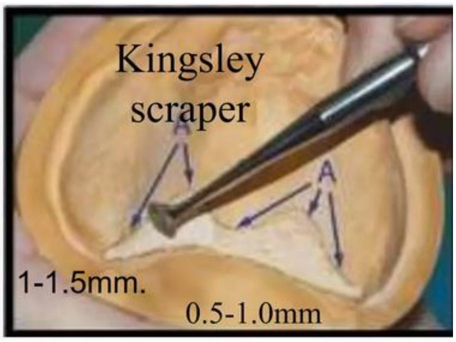
1. **Conventional approach:**

After the special tray is fabricated, there are certain instructions given to the patients:

1. To rinse with astringent mouth wash that is to remove the stringy saliva that might prevent clear transfer marking.
2. Location of pterygo-maxillary notch is done by moving the T burnisher along the posterior angle of the maxillary tuberosity until it drops into the pterygo- maxillary notch. This is necessary as there are times when small depression in the residual ridge may resemble pterygo- maxillary notch.
3. Identification of posterior vibrating line, the patient asked to say "AH" in a normal unexaggerated fashion.
4. Identification of the anterior vibration line. This is done by asking the patient to say "AH" with short vigorous bursts.

Procedure:

- A line is placed with an **indelible pencil** through the pterygomaxillary notch and extended 3-4 mm antero-laterally to the tuberosity area approximating the mucogingival junction, the same is done on the opposite side. This completes the out lining of pterygomaxillary seal.
- The posterior vibrating line is marked with an indelible pencil by connection the line through the pterygomaxillary seal with line just drown demarcation the post palatal seal.
- The resin or shellac tray inserted into the mouth and seated firmly to place, so that upon removal from the mouth the indelible lines will be transferred to the tray.
- Sometimes it is necessary to redefine transfer marking. The tray is return to master cast to complete the transfer of the complete posterior border.
- The tray is trimmed until the posterior vibration line so that it decides the posterior extent of denture border.
- Returning to the mouth the palatal fissure are palpated with the 'T' burnisher or mouth mirror to determine their compressibility in width and depth.
- The termination of glandular tissue usually coincides with the anterior vibrating line.
- The anterior vibrating line now marked and transferred to master cast. This will complete the transferring of the outline of posterior palatal seal area.
- The visual outline is in the shape of cupid bow, the area between the anterior-posterior vibrating lines is usually narrowest in the mid palatal region because of the projection of the posterior nasal spine.
- Carving of the master cast is done using a Kingsley scraper.



Deepest areas are located on either side of the midline, one-third the distance anteriorly from the posterior vibrating line, depth of **1-1.5 mm** is carved. The tissues covering the Mid-palatal raphe are scored to a depth of **0.5-1 mm** because it contains little sub mucosa and cannot withstand same compressive force as the tissue lateral to it. As the seal approaches the anterior vibrating line there is just a slight scraping of the cast. Just posterior to the deepest portion of the seal, it is tapered again towards the posterior vibrating line. Failure to taper the seal posteriorly led to tissue irritation.

Advantages of this technique:

1. The trail base will be more retentive.
2. This can produce more accurate maxillomandibular records.
3. Patient will be able to experience the retentive qualities of the trail base, giving them the psychologic security of knowing that retention will not be a problem in the completed prosthesis.
4. The practitioner will be able to determine the retentive qualities of the finished denture.
5. The new denture wearer will be able to realize the posterior extent of the denture which may ease the adjustment periods.

Disadvantages:

1. It is not a physiologic technique and therefore depends upon accurate transfer of the vibrating lines and careful scraping of the cast.
2. The potential for over compression of the tissue is great.

2. **Fluid wax technique (functional technique or physiological technique):**

All of the procedure remains the same as conventional technique that is transfer location and transfer marking of the anterior and posterior vibrating line.

The marking is recorded in final impression. ZOE/impression plaster (not with elastomeric impression material as they are **resilient**, **non-adherent to wax**, and **distort wax when re-seated into oral cavity**).

One of the four type of wax can be used for this technique:

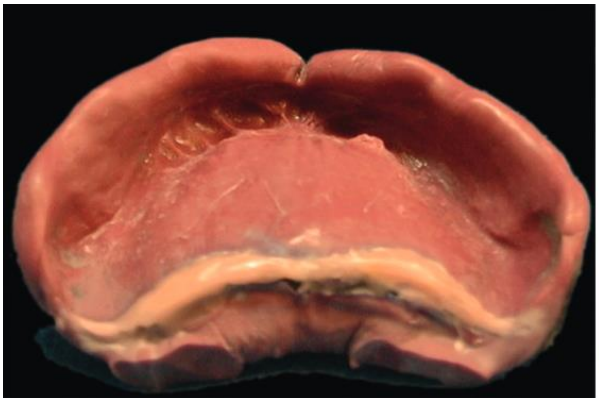
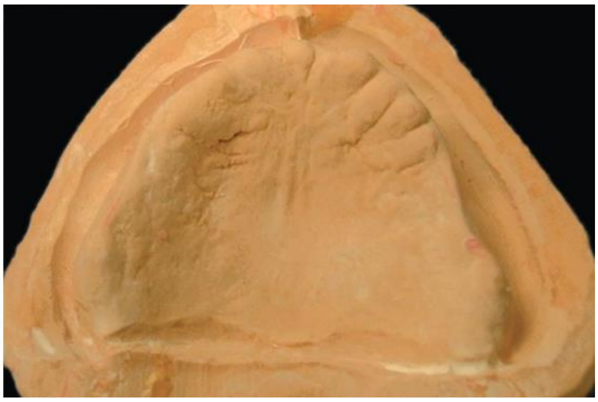
1. Iowa wax white

2. Adaptol green wax.

3. Korecta wax no. 4 (orange).

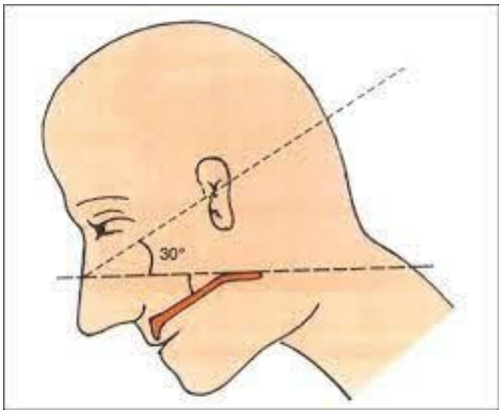
4. H.L physiologic paste (yellow-white) developed by Dr.C.S.Harkins.

These waxes are designed to flow at mouth temperature. The melted wax is painted into the impression surface and in the outline at seal area, usually the wax is applied in slightly excess of the estimated depth and allowed to cool to below mouth temperature to increase its consistency and make it more resistant to flow. The impression is carried to the mouth and held in place under gentle pressure for 4-6 min and allow time for the material to flow.

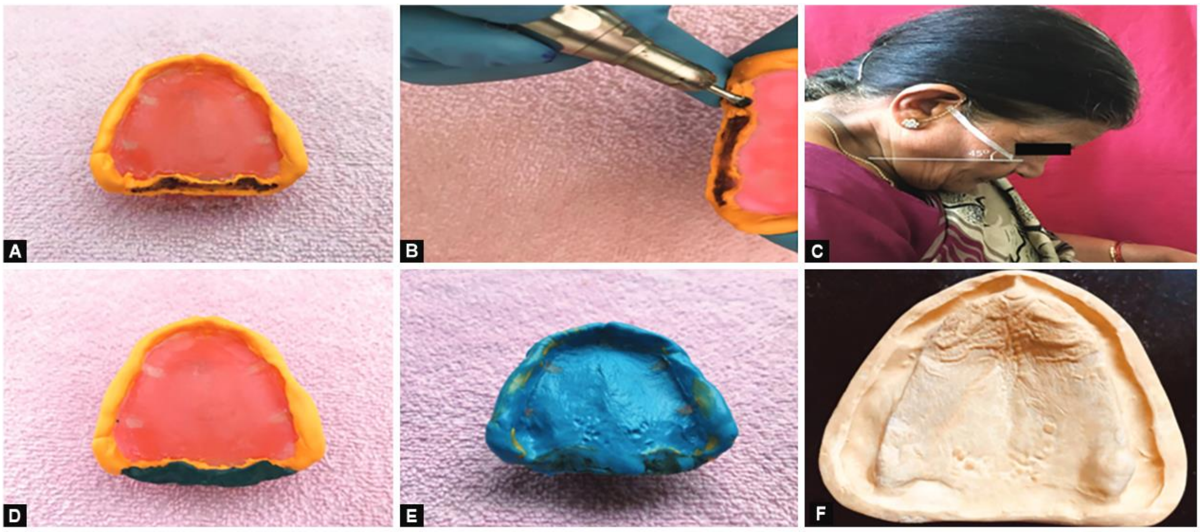



Patient position during impression making of palatal seal area:

An impression should be made when the patient is seated in upright position with head flexed 30 degrees forward, below Frankfort horizontal plane to allow the soft palate to reach its functionally depressed position.



The patient's tongue should be placed under tension against either the handle of the impression tray or the dentist's finger which is held in the region of the upper maxillary incisors. After 4 min remove impression tray, if the tissue contact has been established it will appear glossy. Trim excess (or) if no tissue contact is established then add and redo the procedure.



Figs 1A to F: Steps to record the PPS with the novel functional swallow method: (A) Transfer of the PPS mark onto the elastomeric putty; (B) Roughening and thinning of the elastomeric putty representing the PPS; (C) Patient position for recording the PPS using the functional swallow method; (D) Low-fusing compound representing the PPS; (E) Low-viscosity elastomeric final impression; (F) Master cast with the functionally displaced PPS

A Secondary impression is reinserted and held for 3-5 minutes under gentle pressure followed by 2-3 minutes of firm pressure applied to mid palatal area of the impression tray, upon removal of tray from the mouth it is carefully examined to see wax terminate in feathered edge near the anterior vibrating line.

Advantages:

a. It is physiologic technique displacing tissues within their physiologically acceptable limits.
b. Over compression of tissue is avoided.
c. Posterior palatal seal is incorporated into the trail denture base for added retention.
d. Mechanical scrapping of the cast is avoided.

Disadvantages:

a. More time is necessary during the impression appointment.
b. Difficulty in handling the materials and added care during the boxing procedure.

3. Arbitrary scraping of master cast:

According to Winkler, arbitrarily mark the anterior and posterior vibrating line and scrape about **1-1.5 mm.** It is the **least accurate methods** used to mark the posterior palatal seal. Its high potential for over post damming is due to its nature of unphysiologic technique of recording.

Error in recording of posterior palatal seal:

1. Under extension:

This is the *most common* cause for poor posterior palatal seal. It may be produced due to one of the following reasons:

- **a.** The denture does not cover the fovea palatina, the tissue coverage is reduced and the posterior border of the denture is not in contact with the soft resilient tissue which will move along with the denture border during functional movements.
- **b.** The dentist leaves the posterior border under extended to reduce the patient anxiety to gagging.
- **c.** Improper delineation of the anterior and posterior vibrating line.
- **d.** Excessive trimming of the posterior border of the cast by the technician.

2. Over extension:

Over extension of the denture can lead to:

- **a.** Ulceration of the soft palate and painful deglutition.
- **b.** The most frequent complaint from the patient will be that swallowing is painful and difficult.
- **c.** The hamuli are covered by the denture base, the patient will experience sharp pain, especially during function.

Prevention: These regions are trimmed with a bur and carefully polished.

3. **Under postdamming:**

a. This can occur due to improper head positioning and mouth positioning. e.g., the mouth is wide open while recording the posterior palatal seal, the mucosa over the hamular notch becomes stretched. This will produce a space between the denture base and tissue.

b. Inserting a wet denture into a patient's mouth and inspecting the posterior border with the help of mouth mirror. If air bubbles are seen to escape under the posterior border it indicates under damming.

Prevention: The master cast can be scraped in the posterior palatal area or the fluid wax impression can be repeated with proper patient position.

4. **Over postdamming:**

a. This commonly occur due to excess scraping of the master cast. It occurs more commonly in the hamular notch region.

b. Pterygomaxillary seal area, then upon insertion of the denture the posterior border will be displaced inferiorly.

Prevention: Reduction of the denture border with a carbide bur, followed by lightly pumicing the area while maintaining its convexity.

Addition of posterior palatal seal to existing denture:

Existing denture may have poor length and depth of PPS. Properly examine existing dentures. If there are other problems in the dentures (vertical dimension, centric, aesthetics etc.) then new dentures are to be made. If only PPS is short then correction should be undertaken. Different authors using different materials have advised various techniques.

Moghadam and Scandrett advised the use of fluid wax technique for recording posterior palatal seal and addition of posterior palatal seal with auto polymerizing acrylic resin. A similar technique using softened greenstick modelling compound has been suggested by Carrol and Shaffer.

Other suggested materials for correction of PPS include:

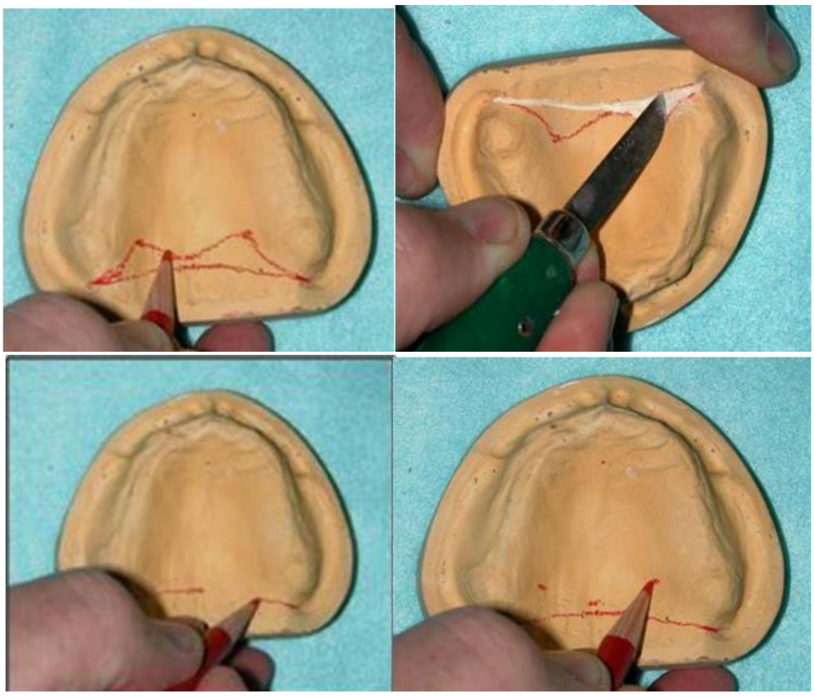
1. Heat cured acrylic resin material.
2. Self-cured acrylic resin.
3. Light cured resin.

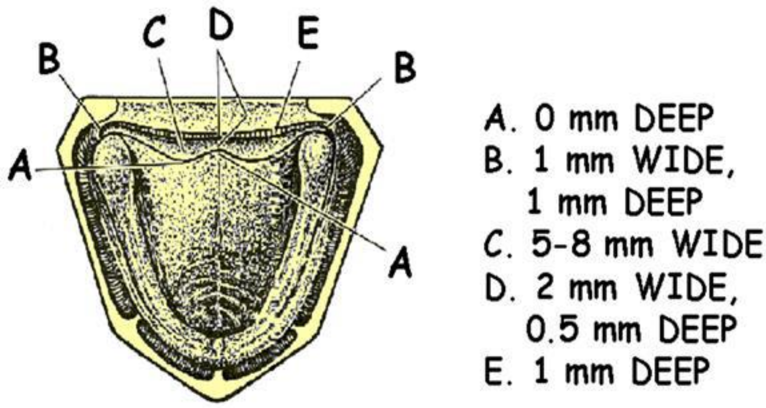
When to record PPS:

There are two schools of thought as to when to record PPS.

a. **Before try in** - provide the patient with psychological confidence.
b. **After try in** to prevent possible mechanical displacement of the trail base by the tissues, which result in an inferior placement of the posterior segment of the denture base leading to occlusal error in 2nd molar region due to improper seating of bases during jaw relation.

Orally, the area of the vibrating line is recorded by making marks with an indelible transfer stick in the fovea palatina area and the hamular notch areas on both sides of the palate and then connecting them with a solid line.





Dimension of posterior palatal seal.

Retention Stability and Support in Complete Denture

Lec.3 **د.صفوان عبد الحميد**

Retention: is the quality of a denture that resists movement away from the tissue.

Factors affect in the retention of CD

1. Anatomical factors.
2. Physical factors.
3. Mechanical factors.
4. Muscular factors.
5. Surgical factor.

1. Anatomical factors:

The various anatomical factors that affect retention are:

Size of the denture bearing area, quality of the denture bearing area

It mainly affects lower denture

a. Ridge form:

1. High and flat crest and well formed in recent extraction. The problem only is no space for setting of teeth
2. Flat one difficult and no retention and stability so in taking the impression try to extend it beyond mylohyoid area to gain more stability and retention.
3. Ridge with undercut more common in upper (bilateral maxillary tuberosity) so we do surgery in one side and block out the other and we have to change the path of insertion.
4. Knife ridge difficult and cause lacerations and pain so we do relief.

5. Flabby ridge fibrous tissue and movable, not good seal so we either modified in the impression technique or do surgical correction.

b. Vault Form:

1. U shaped ⟶ good in retention and stability.
2. V shaped ⟶ have retention but no stability and any pressure on it could break the seal.
3. flat shaped no enough depth, so no retention and stability.

c. Arch Form:

Squared, ovoid, tapered and the best one is the squared. This is because of:

1. there is **4 points of contact with denture**.
2. **Resistant the lateral forces**.
3. **Arch relationship**

Most of edentulous patient have class III ⟶ because of the pattern of bone resorption of the ridges. So, the limited in movement only opening and closing. (**No protrusive movement**)

Some have class II and it isn't favourable because it has small surface area, and difficult to get the upper and lower in contact.

4. **Inter arch distance:** Small interarch space more retention.
5. **Tongue:** If too big ⟶ it could interfere with denture. So, dislodging of the lower and upper.
6. **Mucosa:** We need it Firm, compressible and even thickness. Not to be thick and flabby.

2. Physical factors:

a. **Adhesion:** It's a physical attraction between ***unlike molecule*** like the contact of saliva to both oral tissue and denture base. The amount of retention provided by adhesion is depend on:

1. **Close adaptation of the denture base**
2. **type of saliva** (viscosity and wet ability). Thin serous saliva provides better

adhesion than thick ropy saliva, it builds up pressure & pushes the denture out of position.

3. **Area cover by the denture:** The size of maxillary denture bearing area is about (24 cm^2) & that of mandible is about (14 cm^2)

Mandibular foundation has decreased surface area and hence decreased adhesion. V-shaped palate induces sliding or deflection, hence retention by adhesion is less.

b. **Cohesion:** Its physical attraction between ***like molecules***.

Factor affecting cohesion:

1. Area covered by the denture (cohesion is directly related to the area covered by denture if all the factor are equal)
2. Thickness of the salivary film (saliva film should be thin, watery serous

saliva can form a thinner film and is more cohesive than thick mucus saliva.

3. Adaptation to denture base to mucosa (close adaptation of denture to the

mucosa is needed so that only a thin of saliva is present.

4. Interfacial surface tension: A property of liquids in which the exposed

surface tends to contract to the smallest possibly.

To obtain maximum interfacial surface tension:

1. Saliva should be thin and even.
2. Perfect adaptation should be present between the tissues and denture.
3. The denture base should cover a large area.
4. There denture should have good adhesive and cohesive force to aid to the enhancement of interfacial surface tension.

c. Capillary attraction:

It defined as "*the quality that causes elevation or depression of the surface of the liquid that is in contact with the solid*".

Factors that aid to improve capillary attraction;

1. Close adaptation of denture base to soft tissue. Greater the distance less the capillary force.
2. Greater the size of the denture bearing area greater the capillary attraction retention.

d. Atmospheric pressure and peripheral seal:

When a dislodging force is applied on the denture having good border seal, a negative pressure develops in the space created between the denture base and the mucous membrane. When the negative pressure develops inside, the atmospheric pressure from outside pushes the denture towards the basal seat helping in retention of the denture

Factor affecting atmospheric pressure:

a. Closeness of adaptation to keep air out of tissue contact depends mainly on the

1. impression technique.
2. An impression material that places slight generalized pressure on soft tissue is preferred.
3. Proper border moulding

b. **Peripheral seal**

Is defined as the area of contact between the mucus membrane & peripheral polished surface of denture base to have good peripheral seal

c. **Posterior palatal seal area**

It is defined as "The soft tissue at or along the junction of the hard and soft palates on which pressure within the physiological limits of the tissues can be applied by the denture to aid in the retention of the denture.

The shape of posterior palatal area depends on the shape of palate. According to house classification:

Class I flat - Wide palatal vault in the hard palate so the shape of posterior palatal seal is butter- flay 3-4 mm in width and Width 1.5 depth

Class II intermediate

Class III deep-high vault so the shape of PPS is bead 1mm in depth, Width 1.5 depth.

Function of the posterior palatal seal

1. Aids in retention by maintaining constant contact with the soft palate during functional movements like speech mastication and deglutition.
2. Reduce the tendency for gag reflex as it prevents the formation of the gap between the denture base and soft palate during functional movements.

3. Prevent food accumulation between the posterior border of the denture and the soft palate.
4. Compensates for polymerization shrinkage

e. Gravity

Gravity acts as retentive forces for the mandibular denture and displacement for the maxillary denture when patient is in upright posture.

f. Viscosity

Is the resistance to flow of fluid resulting from intermolecular forces acting within the fluid. Fluid having a high viscosity resist flow more effectively than those of lower viscosity.The additional saliva will cause loss of retention of the denture because of the resultant increase in distance between the denture &mucosa

g. Wettability

For adhesion to be accomplished between a solid & fluid, wetting of solid by fluid must take place. The degree to which this occur depend on relative surface tension. The wetting characteristics may be described in terms of contact angle (high contact angle indicate poor wetting).

3. Mechanical factors:

The varicose mechanical factors which aid in retention are:

1) Undercuts

2) Magnetic force

3) Denture adhesion

4) Suction chambers and suction discs.

1) Engagement of undercut:

Unilateral undercuts aids in retention while bilateral undercuts will interfere with denture insertion and require surgical correction.

If bony undercuts exist, retention may be enhanced by designing a denture that utilizes these undercut areas. In order to achieve this without traumatizing the mucosa" on insertion and removal of the denture, special care is required in planning the path of insertion

2) Magnets.

Intramucosal magnetic aid in increase retention of highly resorbed ridge. Magnetic attachments can significantly improve the retention of mandibular complete over denture. The location of magnetic attachments greatly influences the retentive force of the over denture.

Indication:

Some metal alloys possess magnetic properties which can be utilized in the retention of over dentures or partial dentures.

3) Denture adhesive:

Indications:

1. Denture adhesives are indicated when well-made complete dentures do not satisfy a patient's perceived retention and stability expectations.
2. Patients who suffer from xerostomia.
3. Neurological diseases like stroke and Orofacial dyskinesia
4. Patients who have undergone extensive surgery for removal of Oral Neoplasia

Contraindication

1. Adenture adhesive should not be used for patient with ill- fitting dentures.
2. It should not be used with patient with worn out denture.
3. It should not be used as a substitute to reline or tissue conditioner.
4. it should not be used for patient with physical inability to clean dentures
5. It should not be used in patient with temporary or immediate dentures where infections could result.
6. It should not be used in patient allergic to adhesive

Mode of action of adhesives:

Mechanism of action: it enhances retention through the optimizing interfacial forces by:

1. Increasing the adhesive and cohesive properties and viscosity of the interposed medium.
2. Eliminating the voids between denture base and its basal seat.
3. Increases viscosity of saliva.
4. Hydrated material swells up in the presence of saliva /water.
5. Hydrated material formed by adhesives stick readily to the tissue surface and the mucosal surface of the denture.

Forms of denture adhesive

A- **Powder form**

Start its action immediately with maximum effectiveness &decrease with time.

B- Cream form

Starts its action immediately with accepted effectiveness which increases to maximum within time.

Side effect of denture adhesive:

• High or elevated zinc blood levels.

• Symptoms of nerve damage.

• Numbness or tingling in the Arms and Legs Paraesthesia.

• Anaemia

• Bone Marrow Failure

4) Vacuum device

-It's like a suction chamber Alternative name is rubber disk or palatal window in the past suction chamber in the maxillary dentures were used to aid in retention by create an area of negative pressure which increase retention. They are avoided now due to their potency for creating palatal hyperplasia.

4. Muscular factors:

The oral and facial musculature supply supplementary retentive forces, provided

1) The teeth are positioned in the "neutral zone" between the cheeks and tongue and

2) Polished surfaces of the dentures are properly shaped. For the oral and facial musculature to be most effective in providing retention for complete dentures, the following conditions must be met:

(1) The denture bases must **be properly extended** to cover the maximum area possible, without interfering in the health and function of the structures that surround the denture;

(2) The **occlusal plane must be at the correct level**.

(3) The arch form of the teeth must be in the "**neutral zone**" between the tongue and the cheeks.

The muscles affected on retention are:

A- Buccinators

B- orbicularis oris

C- muscles of tongue

The **accurate approximation** of tongue, cheeks and lip to a denture controls the flow of saliva under the denture, thereby increasing the effective area of retention.

In accurate extension of denture may allow increased saliva and air to enter under the denture & cause loss of retention.

Active muscle fixation of dentures may be obtained by careful attention to the form of those surfaces which contact their environmental tissue.

Denture surface:

Occlusal surface: That portion of the surface of a denture which makes contact or near contact with the corresponding surface of the opposing denture or dentition).

Polished surface: It is that part of the denture base which is usually polished,

includes the labial, buccal and lingual surfaces of the teeth, and is in contact with the lips, cheeks and tongue. Proper contour & design of the polished surfaces should be in harmony with the function of tongue & cheeks to keep the denture in its position. Craddock described the gripping action of the buccinators muscle on the buccal flange of the mandibular denture

If the buccal flanges of the maxillary denture slope Up & out from the occlusal

surface teeth & the buccal flanges of the mandibular denture slope down &out from the occlusal plane, the contraction of the buccinators will tend to seat both dentures on their basal seats

Impression surface: That portion of the surface of a denture that had its shape

determined by the impression. It includes the borders of the denture and extends to the polished surface. The lingual surfaces of the lingual flanges should slope toward the centre of the mouth so the tongue can fit against them & perfect the border seal on the lingual side of the denture.

Lingual flanges turn laterally in posterior part toward the ramus. Also helps ensure the border seal at the back end of mandibular denture."

5. Surgical factors:

1) Vestibuloplasty

2) Tuberoplasty

3) Ridge augmentation

Stability:

that quality of maintaining a constant position in the presence of forces that threaten it; The quality of a denture to be firm, stable or constant and to resist displacement by functional stresses & not to be subject to change of position when forces are applied.

Factors that affecting the stability are:

1. Vertical height of the residual ridge
2. Quality of the impression
3. Occlusal rims
4. Arrangement of the teeth
5. Contour of the polish surface
6. Shape of the palatal Vault
7. Retention
8. Proper relief

Width of the occlusal table must be less than normal teeth to get good stability and retention.

3. **Vertical height of the residual ridge**

The residual ridge should have sufficient vertical height to obtain good stability.

Highly resorbed ridges offer the least stability.

2. **Quality of the impression:**

An impression should be as accurate as possible. The impression surface should be smooth and duplicate all the details accurately. It should be devoid of voids and any rough surfaces. The impression should not warp on removal. The impression should be dimensionally stable and the cast should be poured as soon as possible.

3. **Occlusal plane:**

The occlusal plane should be oriented parallel to the ridge. If the occlusal plane is inclined then the sliding force may act on reduce its stability. The occlusal plane should divide the inter arch space equally.

4. **Teeth arrangement (balanced occlusion and neutral zone):**

The position of the teeth and their occlusion play an important role in the stability of the denture. Balanced occlusion facilitates the even distribution of force across the denture. Absence of the balanced occlusion may produce unbalanced lever type of force at any one side of the denture leading to loss of stability. The teeth in the denture should arrange in the neutral zone.

Neutral zone: the potential space between the lips and cheeks on one side and the tongue on the other. Natural or artificial teeth in this neutral zone are subjected to equal and opposite force from the surrounding musculature"

5. **Contour of the polished surface;**

The polish surface of the denture should be harmonious with the oral structures.

They should not interfere with the action of the oral musculature.

6. **Shape of palatal vault**

A steep palatal vault may enhance stability by providing greater surfaces area of contact & long inclines approaching a right angle to the direction of force.

Hard palate:

Hard palate can be classified as:

1. **U-shaped:** ideal for both retention and stability.
2. **V-shaped:** retention is less as the peripheral seal is easily broken.
3. **round:** reduced resistance to lateral and rotator force.

Stability decreases with:

1. **Loss of vertical height of the ridge**,
2. **Increase in the movement of flabby tissue.**

Support:

The resistance to the forces of mastication, occlusal forces & other forces applied in a direction towards the denture bearing area. The resistance to vertical forces of mastication, occlusal forces & other forces applied in a direction towards the denture bearing area. **Initial denture support** is achieved by using impression procedure that provide optimal extension & functional loading of the supporting tissue.

Nature of the Supporting tissue

The soft tissues should be:

1. In the edentulous person, the mucosa covering the hard palate and the crest of the residual ridge, including the residual attached gingiva, is classified as masticatory mucosa. It is characterized by a well-defined keratinized layer on its outermost surface that is subject to changes in thickness depending on whether dentures are worn and on the clinical acceptability of the dentures.
2. The submucosa is firmly attached to the periosteum of the underlying supporting bone and will usually withstand successfully the pressures of the dentures. (The thickness and consistency of the submucosa are largely responsible for the support that the mucous membrane affords a denture because in most instances, the submucosa makes up the bulk of the mucous membrane. When the submucosal layer is thin, the soft tissues will be non-resilient, and the mucous membrane will be easily traumatized. When the submucosal layer is loosely attached to the periosteum or it is inflamed or oedematous, the tissue is easily displaceable, and the stability and support of the dentures are adversely affected).
3. Covered by keratinized mucosa.

Hard tissue should be:

Relatively resistance to remodelling & resorptive changes. Consideration must be given to the maintenance of alveolar ridge height in the conventional complete denture patient. Minimizing the pressure in those regions most susceptible & directing the forces toward those regions relatively resistance to resorption can maintain healthy residual ridge.

There are **two types of osseous tissue** that form bones:

Cortical bone: It is harder, stronger and stiffer than cancellous bone

Cancellous bone: is less dense, softer, weaker, and less stiff. It typically occurs at the ends of long bones,

Mandibular anatomical consideration:

1. **Buccal shelf area**

The surface of the mandible from the residual alveolar ridge or alveolar ridge to the external oblique line in the region of the lower buccal vestibule. It is covered with cortical bone. Buccal shelf area is the **primary support area** for the mandibular denture because:

1. It's usually covered by mucosa with an intervening submucous layer containing glandular connective tissue & buccinators muscle fibres.
2. It is parallel to occlusal plane.
3. It lined by cortical bone.

Mandibular residual ridge

It is covered by a keratinized layer and is attached by its submucosa to the periosteum of the mandible. The extent of this attachment varies considerably. In some people, the submucosa is loosely attached to the bone over the entire crest of the residual ridge, and the soft tissue is quite movable. In others, the submucosa is firmly attached to the bone on both the crest and the slopes of the lower residual ridge. **The ridges crests are reserved as secondary support areas**.

1) The lack of the muscle attachment

2) Presence of cancellous bone

Maxillary anatomic consideration

1. **Horizontal portion** of the hard palate is considered as **primary stress bearing area** It has keratinized masticator mucosa overlies a distinct Sub mucosa layer everywhere.
2. In the region of the medial palatal suture, the submucosa is extremely thin,

with the result that the mucosal layer is practically in contact with the underlying bone. For this reason, the soft tissue covering the medial palatal suture is non-resilient and may need to be relieved to avoid trauma from the denture base.

3. In the area of the rugae, the palate is set at an angle to the residual ridge and is rather thinly covered by soft tissue. This area contributes to the stress-bearing role, though in a secondary capacity. The submucosa covering the incisive papilla and the nasopalatine canal contains the nasopalatine vessels and nerves.
4. **Crest of maxillary ridge**

The crest of the edentulous ridge is an important area of support. However, the bone is subject to resorption, which limits its potential for support, unlike the palate, which is resistant to resorption. Because of this, **the ridge crest** should be looked on as **a secondary supporting area**, rather than a primary supporting area. The inclined facial surface of the maxillary ridge provides little support,

Although the peripheral tissues should be contacted to provide a border seal. The configuration of the bone that provides the support for the maxillary denture varies considerably with each patient.

Factors that influence the form and size of the supporting bone include:

(1) Its original size and consistency;

(2) The person's general health;

(3) Forces developed by the surrounding musculature;

(4) The severity and location of periodontal disease (a frequent cause of tooth loss).

(5) Forces accruing from the wearing of dental prostheses.

(6) Surgery at the time of removal of the teeth.

(7) The relative length of time different parts of the jaws has been edentulous. In addition, a number of anatomical features influence the shape of the hard palate and residual ridge.

Methods used for improving the retention stability and support, these are described in the following:

• **Dental implants** improve the support, retention and stability of a full or partial denture reducing the slip and movement while speaking or eating.

• **Mini-implants** have become a common treatment option for improving retention of lower dentures.

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Single complete denture

It is a CD maxillary or mandibular may be fabricated to opposed by:

1. An arch containing a sufficient number of natural teeth and fixed restorations so as to not require any other prosthesis.
2. A partially edentulous arch in which the missing teeth have been or will be replaced by a removable partial denture, fixed partial dentures, or implant-supported prostheses.
3. An existing acceptable complete denture, whether it be mucosal-borne, tooth-supported, or implant-supported; the patient may ask for a new single complete denture construction.

Therefore, the conditions leading to the recommendation of treatment by means of a single complete denture can be quite varied.

Glossary of prosthodontics termed this case as a **combination syndrome by Kelly 1972 (Kelly's Syndrome)** which is a destructive problems may be encountered as a result of long term use of a mandibular distal extension partial denture against complete denture: **This syndrome consist of:-**

1. loss of bone from the anterior portion of the maxillary ridge.
2. Overgrowth of the tuberosities.
3. Papillary hyperplasia of the hard palate's mucosa.
4. Extrusion of the lower anterior teeth.
5. Loss of alveolar bone &ridge height beneath the mandibular removable denture bases.

It usually has six associated changes:

1. Loss of vertical dimension of occlusion.
2. Occlusal plane discrepancy.
3. Anterior spatial resorption of the maxilla.
4. Development of epulis fissuratum.

5. Poor adaptation of the prosthesis.
6. Periodontal changes.

The combination syndrome is a result of three main factors:

1. The great magnitude of forces involved.
2. The unsuitability of the denture foundation to resist them.
3. The particularly unfavorable occlusal relationship.

The characteristic features (pathogenses)

Sequence 1:

- The patient will tend to concentrate the occlusal load on the remaining natural teeth (mandibular anterior) for proprioception. So there is more force acting on the anterior portion of the maxillary denture.
- This sequence was trigged due to a negative pressure within the maxillary denture, which causes the anterior ridge to be driven upward by the anterior occlusion, followed by an early loss of bone from the anterior part of the maxilla replaced by flabby tissue, the occlusal plane gets tilted anteriorly upwards and posteriorly downwards due to lacks of anterior support.
- The labial flange will displace and irritate the labial vestibule leading to the formation of epulis fissuratum in the maxillary sulcus.
- This is followed by maxillary tuberosity hypertrophy.
- The shift in the occlusal plane posteriorly downwards produce posterior mandibular resorption in the distal extension denture bearing area, the mandible moves forward, causing a relative (pseudo) mandibular prognathism.
- Due to the tilt of occlusal plane anteriorly upwards during occlusion, the vertical dimension decreased, the retention and stability of the denture also decreased.
- The tilt of the occlusal plane disoccludes lower anterior teeth causing them to super erupt, this will lead to reduction in the periodontal support of them.

- The super eruption of the lower anterior teeth will increase the amount of force acting on the anterior part of the CD and the vicious cycle continues.

Sequence 2:

- There is gradual posterior mandibular resorption in distal extension residual ridge.
- This lead to tilting of occlusal plane posteriorly downwards &anteriorly upwards.
- This cycle will continue.

For such patients; the clinical challenge is one of appreciating the differences in the supporting tissue in the two arches &applying the appropriate management procedures to preserve the remaining tissues as well as restore missing structures to preserve the remaining structures to optimize the functional &esthetic requirements.

The qualitative &quantitative differences between the natural teeth &CD in support is demonstrated by the ability of the natural teeth to respond well to the physiological limits of the occlusal load in a way help to maintain functional &preservation requirements; while the mucoperiosteal supported denture is incapable to adapt such a condition in same level with the natural teeth.

Jaw relationship extreme:

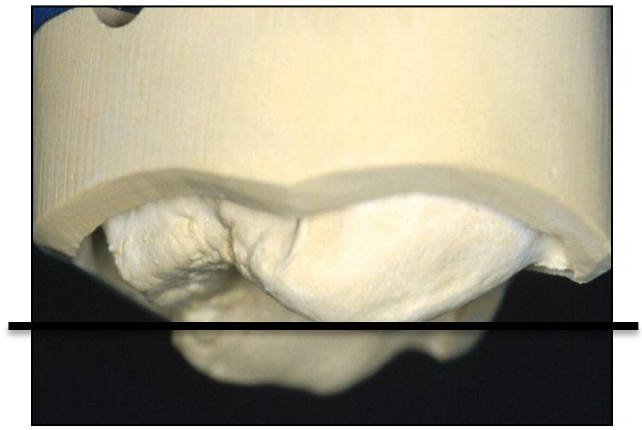
This makes it difficult to place the denture teeth in a position that allows the denture bearing area to be in line with occlusal support; as in CL.III skeletal relationship. This result in cross bite posterior teeth arrangement while anterior teeth cannot be set lingual to the lower anterior teeth &the risk foe denture dislodgement with anterior tooth contact is problematic.

Excessive displaceable denture bearing tissues:-

In denture; the forces of occlusion are resisted by mucoperiosteum which allows some movement of the denture base by its resiliency. When tissue displacement allow excessive displacement in one area but not in another; the movement of the prosthesis under load is greater in the region of greater tissue displacement with resultant dislodgement.

Irregular occlusal plane:

This is often is seen as a tilting or extrusion of teeth after the extraction of a mandibular first molar the 2^{nd} &3^{rd} molars are inclined anteriorly; this lead to a superior position occlusal plane than normal. This result in an irregular occlusal plane &consequently unfavorable force distribution. This indicated the need for selective grinding, with a template placed on the dental arch. The device will rest on the most prominent teeth to ensure enough number of teeth are in contact.



This provides a uniform reduction but may not meet the need of a specific denture arrangement for stable cross arch balance. A frequent obstacle to obtaining a balanced occlusion is an irregular occlusal plane of the teeth in the opposing arch, as a result of supra-eruption or tilting of teeth. A consequence of this irregular plane is an unfavorable distribution of forces. The irregular occlusal plane may also compromise the final esthetic outcome of the single denture.

Clinical and laboratory steps:-

Preprosthetic work:-

Different patients with particular clinical findings should be treated specifically to prosthodontically rehabilitate them and prevent combination syndrome. Therefore consider the following individually (it is not essential to have all the complications in every patients).

- Treatment of the abused tissues by using tissue conditioners, occlusal adjustment& extension correction of the existed denture; you may ask the patient not to wear old denture. Surgical correction may be needed according to the extension &severity.

- Reduction enlarged tuberosities; surgically to allow the lower RPD occlusion to oriented properly in relation to the retromolar pad area &buccal shelf area.
- Splinting the remaining mandibular anterior teeth to provide the RPD with positive occlusal support, rigidity &stability, while minimizing excessive stress on the ant. natural teeth; in this way provide posterior &to minimize occlusal pressure in the ant. maxilla.
- Surgical intervention (vestibuloplasty &excision of flabby tissue).
- Occlusal plane adjustment; this might be done by simple controlled grinding to correct minimal interferences. Moderate to severe interferences may indicate crown construction with regard to all the principles of crown &bridge restorations.

Individual tooth modifications: sharp unworn cusps ⇨ reduce cuspal inclination
Heavily abraded teeth ⇨ reduce Bu-Li width (in some cases due to extension of posterior teeth; anterior teeth are used in function this may lead to teeth attrition).

Occlusal adjustment of the natural teeth is preferable to accomplished in the diagnosis step ,but in certain cases this may be done or further adjustment can be done at the try-in visit. Natural teeth adjustment must be as much as needed only take your time to decide the areas &extent of tooth needed to be removed; plan this adjustment by using a casts & articulator even splints can be constructed to guide this adjustment.

This problem may need orthodontic repositioning of the opposing teeth-indications &age with orthodontic considerations or by altering the clinical crowns of the teeth by means of selective grinding or with restoration. Of course, the clinician may be forced to accept good centric occlusion contacts &premature contacts in the eccentric positions. The excessive premature contacts often cannot be eliminated therefore proper occlusal relation considering some modification.

Several technique could be used to determine occlusal modifications that are necessary prior to denture construction:

1. **Yurkstas technique**: use of a commercially available U-shaped metal occlusal template that is slightly convex on the lower surface. This template is often an aid in detecting minor deviations in the occlusal scheme.
2. **Swenson's technique**: upper and lower casts are mounted on the articulator. The upper denture is constructed. If the lower natural teeth interfere with the placement of the denture teeth, they are adjusted on the cast and the area is marked with a pencil. The natural teeth are then modified using the marked diagnostic cast as a guide. This technique is simple but time consuming.
3. **Bruce technique** use of a clear acrylic resin template fabricated over the modified stone cast. The inner surface of the template is coated with pressure indicating paste and placed over the patient's natural teeth.

- **Improvement of the denture foundation areas** as augmentations or grafting; dental implant is a strong choice.
- **Diagnostic casts** in most cases is essential to chart the treatment planning &modifications required; in some cases even teeth corrections may be made on the casts to ensure efficacy of these modifications &its approximation to the functional movements &needs of each patient.

Primary impression:-

In an ordinary cases; primary impression can be made as usual, use a stock tray &suitable impression material. If a movable tissue in the upper or lower ridge crest is detected; it is better to use modify the impression technique or material to minimize tissue displacement during impression. Special tray constructed using autoploymerized acrylic; areas require relief & final impression technique must be considered.

Final impression:-

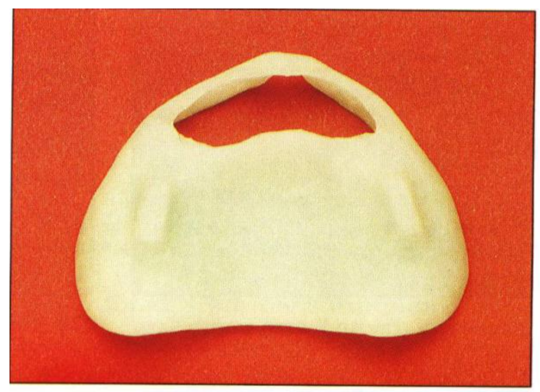
In cases where the flabby or mobile tissues is diagnosed; selective pressure or minimum pressure or even non pressure impression technique must be used in the final impression.

☒ **First model:**

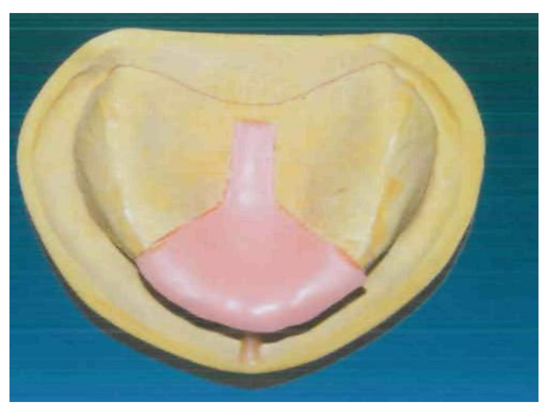
1. The places with flabby mucosa were delineated &as well the places on the "medaina palatine raphe" &" torus palatinus".
2. Those spots were then covered with a wax layer.
3. After that an individual tray is formed.
4. Holes are drilled at the places corresponding to the critical spots mentioned earlier with a space approximately 5mm apart.

☒ **Second model:**

You can follow same steps in the 1st model but instead of putting holes you prepare a window at the delineated areas of flabby tissues. You must use an impression material making. Plaster of Paris impression materials is mostly the material of choice. It can be applied in a layers with a brush to produce the desired need. Silicon light body alone or in combination with regular body can be used in a proper material handling.



☒ **Third model:**



1. On this model the areas of movable- flabby tissues are delineated as well as the areas need relief as the torus palatinus-if present.
2. Then relieved with a layer of wax in a uniform thickness.
3. Another base plate wax covered the whole

basal seat i.e. the surface outlined for tray.

4. Wax is cut away in locations where stops are desired; usually we place them in the areas opposed to the canines &1st molars.
5. The tray is completed with the wax spacer as relief.
6. Holes are drilled at the places corresponding to the flabby tissues areas &torus palatinus.

The materials used in final impression is either single type with light consistency &good flow or you may use more than one type-combination- depending on the stress bearing &relief areas.

Jaw relation records:-

Maxillary occlusion rim is constructed with tripod or stable centric stops if possible to record centric jaw relation with wax or other suitable material. If opposing mandible is partial edentulous this indicates construction of lower occlusion rim to have a stable jaw relations.

1. A face bow registration is made &a cast mounting must be either by using an average value articulator or using semi adjustable articulator that indicates a protrusive relation record.
2. Recording vertical jaw relation may be interfered with the over erupted or malposed teeth; these may require some modification in the bite rim orientation but this must be made in a local areas without- as possible- interference with the proper orientation of occlusal plane.
3. Using gothic arch tracer for CR, or using zinc oxide paste or wax for recording CR.
4. Freeing the anterior occlusion rim.
5. Incisal guidance is set according to the need. Aesthetic of the denture will influence the angle of incisal guidance because of the vertical position of the anterior teeth with various vertical overlap used.

Selection of teeth:

Selection of teeth is important to establish functional &esthetic requirements. Teeth material &location must be evaluated &verified inside the patient's mouth to decide its suitability.

Type of the teeth:

Acrylic teeth it don’t cause wear in the opposing natural teeth. It was the teeth of choice, it tend to reduce stress concentration on the maxillary anterior ridge but the major disadvantage that it will abraded more easily than porcelain teeth, which result in loss of vertical dimension, improper stress distribution; with the time when residual ridge resorption of the arches is continued physiologically, the denture retention &stability may affected greatly, these changes in the teeth form after denture insertion neccessate periodic recalls.

Porcelain teeth Never use it opposing to natural because it lead to natural teeth attrition; therefore it is better to let denture teeth to wear rather than the natural one. Porcelain teeth has a good wear resistance; although it is good property but this may lead to:

- Excessive load on the ridge.
- Patient with a single CD need frequent occlusal adjustment to accommodate changes in the basal area &porcelain teeth are difficult to be adjusted.

Acrylic teeth with metal occlusal surface like gold can serve stable occlusion. It can use in patient with financial resources, it minimize wear of the occlusal surfaces and it considered the best material to opposed natural teeth, but they are expensive and need time in their fabrication.

Acrylic teeth with amalgam stop it can use in patient with limited financial resources, amalgam stops can be inserted into the cusp tips of the acrylic resin denture teeth to reduce the occlusal wear, and this technique is simple, less time consuming and less expensive than with the gold occlusion.

To select teeth material you have to consider:

- Opposing teeth, natural or artificial.
- Selected occlusion concept that control function load.
- Remaining teeth alignment; some cases may require reduced teeth number.
- Need for future adjustment.
- Type of denture base material; acrylic or metal.
- Patient history with previous denture-if present- &any problems.

Teeth setting:

Setting of artificial teeth must be done properly with vertical overlap &inclination but in some cases you should not follow the occlusal plane of the opposing teeth because it is mostly not ideal due to extraction, proclination &extrusion. Occlusal forces must be directed vertically toward the supporting tissues to enhance occlusal stability; this may be achieved even if in some cases you cannot place maxillary molars in a maximum intercuspations when opposed natural teeth with steep inclinations. You may reduce these steep inclines to optimum results.

Occlusion:-

-Prevention of the combination syndrome must be our primary objective. Restoring a stable posterior occlusion, while minimizing occlusal pressures on the anterior maxilla. In most of the case even if no contact anteriorly was provided; overtime contact occurs.

-A bilateral balanced occlusion of the posterior teeth using pantographic recordings transferred to a fully adjustable articulator to stabilize the maxillary denture.

-Another way of potentially increasing the stability &retention of the single denture is to use anatomic form posterior denture teeth & a balanced occlusal scheme. By providing balancing contacts when the patient moves through the eccentric movements, the denture is not subjected to tipping forces that can lead to its dislodgement. If the opposing dentition has been worn flat &is not being restored, a monoplane denture setup may accomplish same result, so, selecting of occlusal concept depend on the occlusal anatomy of the opposing teeth:

Opposing teeth anatomic then balanced occlusion is used.

Opposing teeth are attrited the monoplane occlusion is used.

Try-in step:-

- The teeth in a wax trial denture must be evaluated in CR on the articulator; evaluation of the occlusion in eccentric relations also.
- Modification of teeth position are made to provide balance stable cross arch balance within functional movement (2mm).
- The denture arrangement &all necessary natural teeth modification can be accomplished on the opposing stone cast to mark the location& extent of modification.
- Other methods of teeth adjustment can be used depending on the case &dentist's experience.(teeth adjustment must be determined at diagnosis step)

Denture fracture:-

Fracturing the denture base of the single denture is a common complication because the denture is often opposed by a full or nearly full complement of natural teeth or fixed restorations. The restating high occlusal forces on the denture combined with a typical denture base thickness sometimes results in fracture. Careful control over the occlusion or use of a cast metal base are considerations to prevent this problem. The precipitating factors of this condition could be :-

1. Excessive anterior occlusal load.
2. Deep labial notch.
3. High excessive load due to excessive action of masseter muscle.

Treatment:

1. Check for occlusal contacts.
2. Adequate &even denture base thickness.

3. Do not deepen or improperly shape the labial notch.
4. Cast metal denture base may solve the problem in cases with high fracture potential.

MANDIBULAR SINGLE DENTURE:

The prognosis of a mandibular single denture against natural teeth is less favorable than when the full upper denture is opposing by natural lower teeth. It would be difficult to classify this case as clinically successful. ***Maxillary single dentures are often more successful than mandibular- dentures for a number of reasons:***

1. the mandibular arch is the moveable member of the stomatognathic system (mouth, jaws, and related structures), which inherently decreases its stability.
2. the proximity of the mandibular denture borders to the tongue and other moveable mucosa may lead to easier displacement.
3. the mandibular edentulous ridge, with its limited amount of attached submucosal tissue, provides less support for the denture base.
4. Excessive resorption of the lower ridge due to greater stresses per unit area delivered to the mandibular ridge by the natural teeth.
5. Denture bearting area in mandible less than maxilla.

Therefore, if stability of the single denture is of primary importance for its success, it is clear why patient satisfaction is greater with maxillary single dentures. It has been estimated that lower canines are the teeth retained for the longest. This may suggest that upper teeth are lost before lower arch. The exact reasons are unclear although dental profession's perceptions of the ease &success of upper CD is more than lower CD is may be one major factor.

Problems of single denture:

1. Greater magnitude of forces, lead to change in the underlying bone, the denture will compromised.

2. Occlusal form of the remaining natural teeth, this occlusal form dictates occlusal form of the denture teeth which might be un suitable for denture.
3. Occlusal scheme causing more horizontal forces.

<u>These factors causes occurance of:</u>

- Single denture syndrome..
- Damage of mucosa.
- Ridge resorption.

Alternative treatments &options:

It is clear &well understood the subsequent of single CD construction. Therefore, it is advisable always try to prevent this condition as possible.

1. Planned extraction with immediate denture construction.
2. Over-denture with metal denture base.
3. Using of denture liners with periodic recall for occlusal adjustment &liner replacement.

4. Dental implants: this is regarded as a solution for this condition whenever it is indicated. Dental implant serve as a natural tooth in a limit anchored in the bone that may solve a lot of the single CD associated problems. Stability &retention of the single denture can be increased by means of adjunctive treatment using dental implants &attachments. Dental implants have the added benefit of preserving alveolar bone. This is even more important for the younger patients who, after many decades of support loss, may find themselves unable to tolerate denture.

In new cases of single CD, the dentist must preserve the foundation areas &restore function &esthetic needs of the patient by construction of the prosthesis &always prevent the destructive changes due to denture insertion. Patients with old single CD, the improvement of the denture foundation area &proper denture construction that preserve the remaining tissues &serve function &esthetic.