# Crown & Bridge

**Lecture 1** **Dr Farid**

## Prosthodontics (prosthetic dentistry or prosthodontia)

The dental speciality that concerned with restoring & maintaining oral functions, comfort, appearance & health of the patients by making artificial replacements for missing parts of the mouth and jaw.

**Branches of Prosthodontics**

**1.** Fixed Prosthodontics FPDs.

**2.** Removable Prosthodontics.

a) Complete Denture.

b) Removable Partial Denture RPDs.

**3.** Implant Prosthodontics.

**4.** Maxillofacial Prosthodontics.

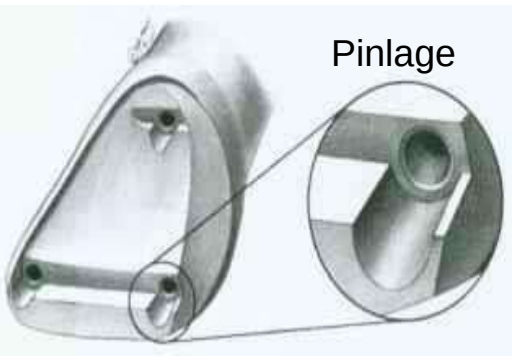
**Fixed prosthodontics (Crown & Bridge Prosthodontics):**

It's a branch of dental science that deals with restoring damaged teeth with artificial crown & replacing the missing natural teeth by a dental prosthesis permanently cemented in place (Fixed partial denture).

**Types of Fixed Prostheses:**

**1)** Extracoronal: It involves all restorations that seat over the tooth such as all types of crown restorations (Full metal crown, partial crown, PFM, all ceramic crown) & direct or indirect veneer restoration.

**2)** Intracoronal: It involves all restorations that seat inside the tooth such as inlay, onlays, pinlage.


**The Crown:** It's a fixed extracoronal artificial restoration for the coronal portion of a natural tooth. It must restore morphology, function & the contour of the damaged portion of a tooth and must protect the remaining tooth structure from further damage.

**Types of crowns: (Classifications)**

**A) According to the coverage area**

1. **Complete crown:** It covers the coronal portion of the tooth, such as full metal crown, All- ceramic crown (made of ceramic material).
2. **Partial Crown:** It is covers part of the coronal portion of the tooth such as ¾ Crown and 7/8 Crown.
3. **Complete replacement:** it involves those which replace the natural crown entirely while retains itself by means of a metal extended inside the root canal space of the tooth such as a post crown.

**According to materials used in the construction of C&B restorations**

1. **Metal Crowns:** Gold alloy and its alternatives
2. **Non-Metal crowns:** Acrylic resin, Zirconium or Porcelain as in jacket crown.
3. **A combination:** of metal and plastic materials as in PFM crown restorations.

## Fixed Partial Denture (Bridge)

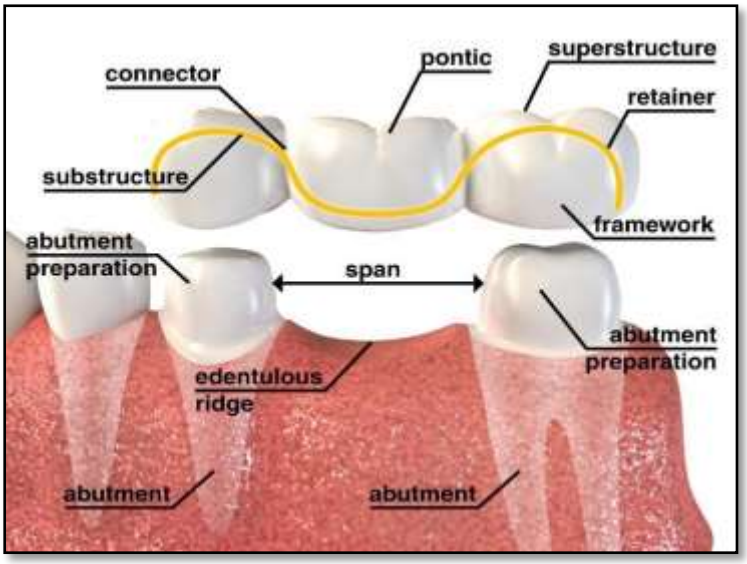
It is a fixed dental prosthesis (appliance) which replaces and restores function and aesthetic of one or more missing natural teeth. It cannot be removed from the mouth by the patient and primarily supported by natural teeth or root.

## Components of the bridge:

1. **Retainer:** It's the part that seat over (on or in) the abutment tooth connecting the pontic to the abutment. It is either major or minor retainer, or it could be crown, inlay, post & core.

2. **Pontic:** It is the suspended member of fixed partial denture that replaces the missing tooth or teeth, usually it occupies the position of the missing natural tooth.

3. **Connector:** It's the part that join the individual components of the bridge together (retainer& pontics), which could be fixed (rigid) or movable (flexible) connector. When the retainer is attached to a fixed connector it's called a major retainer, but when it is attached to a flexible (movable) connector it is called a minor retainer.



**Definitions**

**Abutment**: a tooth to which a bridge is attached.

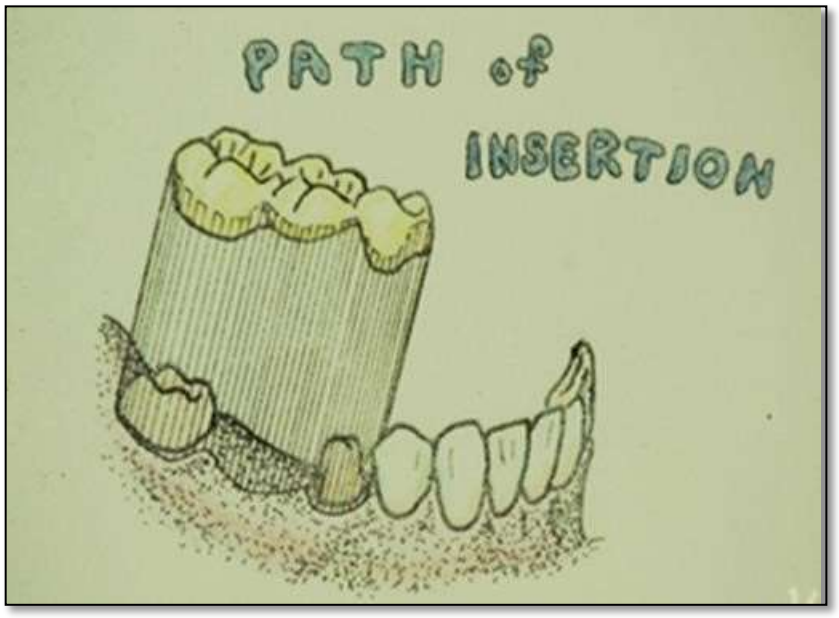
**Span:** is the space between natural teeth that is to be filled by pontics.

**Saddle:** is an area of the edentulous ridge over which the pontic lies.

**Pier:** is an abutment standing between two abutments & supporting two pontics, each pontic being attached to further abutment.

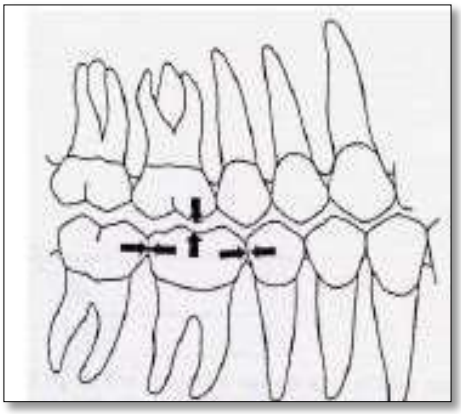
**Unit:** when applied to bridgework, means either a retainer or a pontic, thus a bridge that replaces a premolar using two abutments is referred as three Unit Bridge.

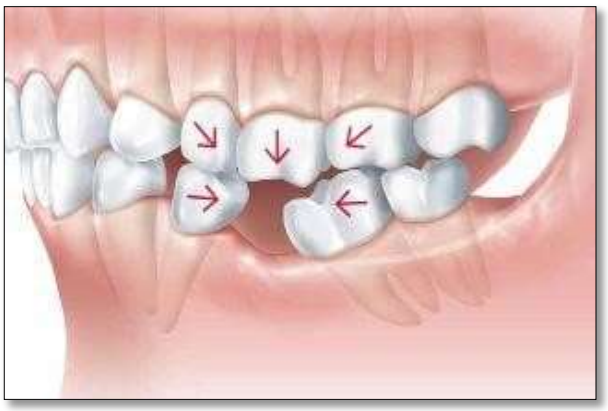
**Path of insertion:** An imaginary line along which the restoration can be inserted and removed without any interferences or causing lateral force on the abutment.



**Why do a Fixed Partial Denture?**

The stability of an individual tooth depends on a balance of the forces exerted on that tooth by the adjacent, opposing teeth, supporting tissue & by the soft tissue of the cheek, lips & tongue





When a single tooth is not replaced (after loss), this balance is upset, & the consequence may by:

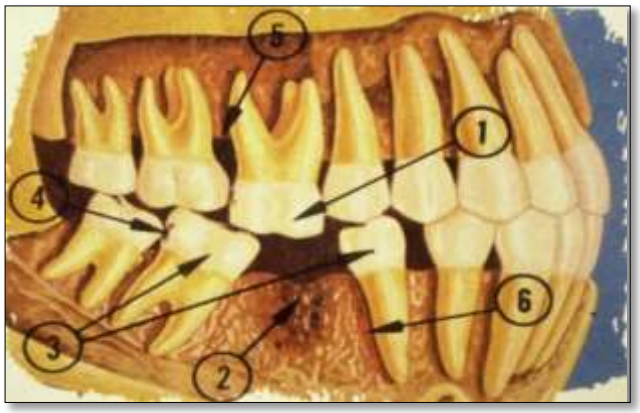
**1. Super eruption of the opposing tooth or teeth:**

a) Gingival recession

b) Traumatic occlusion or lacking of bite

c) Loss of bony support for that tooth.

d) Loss of the proximal contact




**2. Loss of function on the affected side:**

a) Diffuse atrophy.

b) Heavy deposition of plaque & this lead to gingivitis & periodontal disease.

c) Trauma to the soft tissue during function.

d) Loss of tissue (contraction of both soft tissue & alveolar bone).

**3. Tilting (drifting) of the adjacent teeth.**

**4. Loss of the proximal contact to:**

a) Food stagnation & pocketing

c) Sub-gingival caries

**5. Periodontal problem & mobility**

**Posterior Bite Collapse:**

The posterior teeth support the vertical height of the face. If they are lost, the face tends to lose height and close down; this is called “posterior bite collapse”


Figure 1: The back teeth and front teeth work in harmony. The back teeth support facial height & chew food while the front teeth cut food, protect the back teeth in lateral jaw movements and provide your smile


**Figure 2:** The loss of the back teeth places excessive pressure on the front teeth causing shifting of teeth and slight loss of facial height.


**Figure 3:** Without replacement of the back teeth, the teeth start to shift and excessive pressure causes the front teeth to spread forward. Loss of facial height occurs

**The general effects of tooth loss:**

**1)** Generalized collapse of lower & upper dental arches.

**2)** Premature contact causing deviation in the normal movement of the mandible which might lead to TMJ dysfunction & muscle spasm that cause pain.

**3)** Tooth loss may lead to unilateral mastication on the opposite side of the dental arch which results in periodontal problems, caries on the affected side due to deficient mechanical cleaning afforded by the act of mastication.

**4)** Posterior bite collapse these changes also put pressure on the front teeth which tend to move or splay forward.

Treatment at this stage prevents further disruption, it may be insufficient to ration back to full health, it need extended treatment plans including, ortho. Treatment, additional cast restoration to correct the disturbed occlusal plane.

**Reasons for treating tooth loss:**

**1)** Aesthetic.

**2)** Function (ability to eat).

**3)** Pain due to TMJ dysfunction & muscle spasm

**4)** Maintenance of dental arch (occlusal stabilization & prevent tilting)

**5)** Speech (particularly lower incisors).

**Methods of treating tooth loss**

- Orthodontic.
- Removable partial denture.
- Fixed partial denture (tooth supported partial denture).
- Implant (Osseo-integrated implant).
- Combination.

**In some case the decision might be no prosthetic treatment**

1) Long standing edentulous space (long span) into which there has been little or no drifting or elongation of the adjacent teeth.
2) Lack of distal abutment.
3) If the patients perceive no functional, occlusal or aesthetic impairment.

## Steps in crown construction:

**1-** Diagnosis

**2-** Tooth Preparation.

**3-** Final impression.

**4-** Temporary restoration.

**5-** Construction of working model.

**6-** Waxing.

**7-** Investing.

**8-** Wax Elimination.

**9-** Casting.

**10-** Finishing and polishing.

**11-** Cementation of the restoration.

## History:

A patient history should include all necessary information concerning the reasons for seeking treatment, along with any personal details and past medical and dental experiences that are pertinent. It is important that a good history be taken before the initiation of treatment to determine if any special precautions are necessary.

Chief complaint:

The accuracy and significance of the patient's primary reason(s) for seeking treatment should be analysed first. This may be just the tip of the iceberg and careful examination will reveal problems and disease of which the patient is often unaware: nevertheless, the patient perceives this chief complaint as the major problem. The inexperienced clinician trying to prescribe an "ideal" treatment plan may lose sight of the patient's wishes.

Chief complaints usually fall into one of the following four categories:

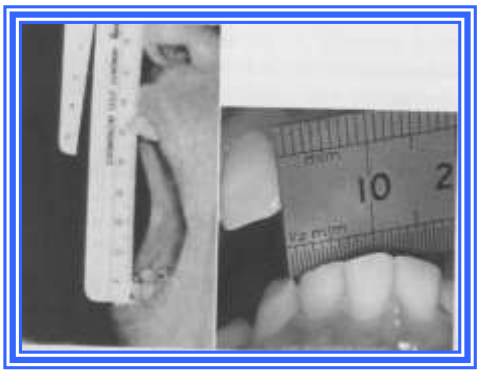
- Comfort (pain, sensitivity, swelling)
- Function (difficulty in mastication or speech)
- Social (bad taste or odour)
- Appearance (fractured or unattractive teeth or restorations, discoloration)

## Extra oral examination

- **Evaluation of the TMJ:**

The clinician locates the TMJs by palpating bilaterally just anterior to the auricular tragic while having the patient open and close. With light anterior pressure helps identify any potential disorder in the posterior attachments of the disc.

Tenderness, clicking, or pain on movement is noted, maximum jaw opening of less than 40mm indicates restriction, because the average opening is greater than 50mm. Any deviation from midline is also recorded. Maximum lateral movement can then be measured (normal is about 12mm).



- **Muscles of mastication.**

Many patients suffer from muscle pain as a result of parafunctional jaw activity related to stress or sensitivity to faults in their occlusion. Habits such as clenching the teeth and "playing with the bite" during the course of the daily routine may result in fatigue and muscle spasm.

A brief palpation of the masseter, temporalis, medial pterygoid, lateral pterygoid, trapezius, and sternocleidomastoid muscles may reveal tenderness. Palpation is best accomplished bilaterally and simultaneously.

## Lips

The clinician next observes the patient for tooth exposure during normal and exaggerated smiling. This may be critical in treatment planning and particularly for margin placement of metal-ceramic crowns. Some patients show only their maxillary teeth during smiling. More than 25% do not show the gingival third of the maxillary

central incisors during an exaggerated smile. The extent of the smile will depend on the length and the mobility of the upper lip and the length of the alveolar process.

When the patient laughs, the jaws open slightly and a dark space is visible between the maxillary and mandibular teeth. This has been called the negative space. Missing teeth, diastemas, and fractured or poorly restored teeth will disrupt the harmony of the negative space and often require correction.

**Intra oral Examination:** The patient's general oral hygiene…

- The amount of plaque on the teeth.
- The existence of pockets should be entered in the record and their location and depth charted. The presence and amount of tooth mobility should be recorded.
- The condition of prospective abutment teeth, note the presence and location of caries, the areas of gingival lesions and decalcification, and evaluation of plaque retention, can offer some prognosis for the new restorations. It will also help to determine the preparation designs to be used.
- Previous restorations and prostheses should be examined carefully, to determine their present suitability or their need to be replaced. The age of existing restorations can help establish the prognosis and probable longevity of any future fixed prosthesis that may be indicated.

## Evaluation of occlusion:

The patient's occlusion must be evaluated to determine if it is healthy enough to allow the fabrication of such restorations. If the occlusion is within normal limits, then all treatment should be designed to maintain that occlusal relationship.

If the occlusion is dysfunctional in some manner, further appraisal is necessary to determine whether the occlusion can be improved prior to the placement of the restorations or whether the restorations can be employed in the correction of the occlusal problem.

- **Initial tooth contact (centric relation)**

The relationship of teeth in both centric relation and the intercuspal position should be assessed. The centric relation position (CR) of the patient should coincide with the maximum intercuspation (MI).

- General alignment

The teeth are evaluated for crowding, rotation, supra-eruption, spacing, and malocclusion.

Tipped teeth will affect tooth preparation design or in severe cases, need for minor tooth movement before restorative treatment.

- **Lateral and protrusive contacts**

In the presence or absence of tooth contact in eccentric movements, teeth may exhibit hypermobility, open contacts, or abnormal wear. Hypermobility of an individual tooth or opposing pair of teeth is called (fremitus), which often an indication of excessive occlusal force. Such contacts frequently can be detected by placing the tip of the index finger in the mucobuccal fold over the root portion of the mobile tooth and asking the patient to tap the teeth together

## Diagnostic casts:

Articulated diagnostic casts can provide a great deal of information for diagnosing problems and arriving at a treatment plan.

They allow an unobstructed view of the edentulous spaces and an accurate assessment of the span length, as well as the occlusogingival dimension. The curvature of the arch in the edentulous region can be determined, so that it will be possible to predict whether the pontic(s) will act as a lever arm on the abutment teeth.

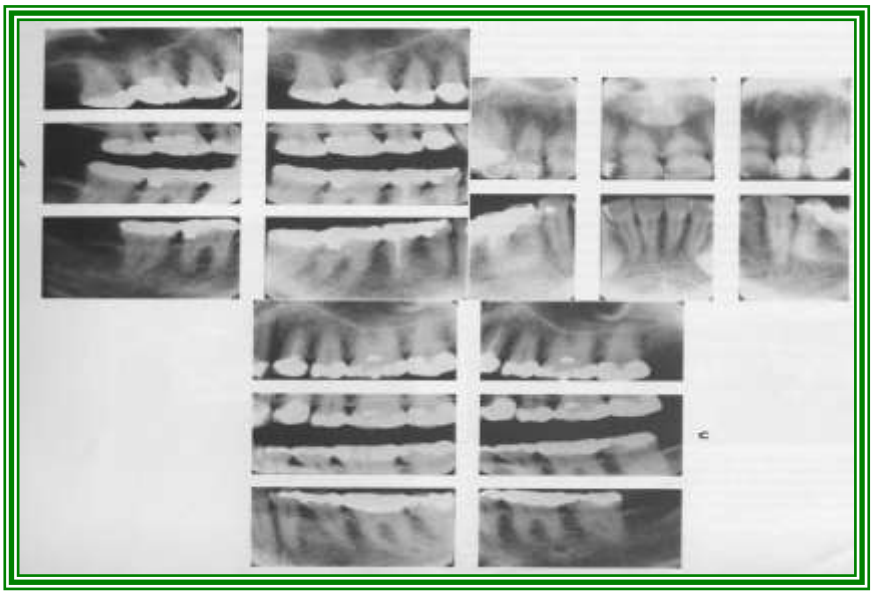
The length of abutment teeth can be accurately gauged to determine which preparation designs will provide adequate retention and resistance.

The true inclination of the abutment teeth will also become evident. Mesiodistal drifting, rotation, and faciolingual displacement of prospective abutment teeth can also be clearly seen.

## Full-mouth radiographs (periapical series):

Radiographs are the final aspect of the diagnostic procedure. The radiographs should be examined carefully for:

❋ Signs of caries, both on unrestored proximal surfaces and recurring around previous restoration.
❋ The presence of periapical lesions, as well as existence and quality of previous endodontic treatment, should be noted.
❋ General alveolar bone levels, with particular emphasis on prospective abutment teeth, should be observed.
❋ The crown-root ratio of abutment teeth can be calculated.
❋ The length, configuration, and direction of those roots should also be examined.
❋ The presence of retained root tips or other pathosis in the edentulous areas should be recorded.



Reference: Contemporary Fixed Prosthodontics

# Crown & Bridge

**Lecture 2** **Dr Farid**

## Fixed Partial Denture

**Indications**

### A) General:

**1-** Psychological: The FPDs are rapidly tolerated by patients than RPDs

**2-** Systemic: as in epileptic patients (attack of unconsciousness), the FPDs have adequate strength & retention, while in RPD, there is a potential for fracture or inhalation.

**3-** Orthodontic consideration: FPDs are indicated for stabilizing the orthodontic results (e.g., FPD used to replace missing lateral incisor after diastema between two centrals has been closed).

**4-** Speech: RPDs are bulky, which cause difficulty in speech. In contrast, in FPDs, the size of pontics are similar to the missed teeth which rarely cause difficulty in speech.

**5-** Periodontal reasons: FPDs can stabilize teeth with minor mobility using fixed splint (bridge), to prevent further movement that leads to drifting or over extrusion with more loss of bony support, additionally, to ensure that the mastication forces are eventually distributed over several teeth rather than overloading on a tissue that is seriously weakened by the disease.

### B) Local:

**1)** The bridges are indicated wherever there are properly distributed healthy teeth that serve as abutments.

- ✓ Vital tooth or endodontically treated with no radiographic evidence of pathology

- ✓ Adequate crown/root ratio
- ✓ Good periodontal condition
- ✓ Root configuration & angulations

**2)** Tooth suitable as abutment which require cast restoration (the same tooth lie adjacent to edentulous space & suitable as abutment).

**3)** Unfavourable angulations of teeth for removable prosthesis (badly tilted teeth).

**4)** It is advisable to restore edentulous space with fixed rather than RPD, because the force of occlusion transmitted to periodontium, then to the alveolar bone (natural), while in the RPD the occlusal force is transmitted to muco-periostium, and then the underlying bone (which is not designed for this function).

## Contraindications:

### A- General:

**1-** Uncooperative patient: difficult to achieve satisfactory result.

**2-** Social problem: FPDs are more expensive than RPDs. Usually the patient must be given what he wants, which makes him sometimes unsatisfied for the results.

**3-** Occupation: boxers, hockey players, and pipe smokers are not advisable for FPDs (fracture of teeth or restorations)

**4-** Poor oral hygiene: The bad attitude toward dentistry limit the decision to make FPDs unless the patients are positively motivated before treatment.

**5-** Age: FPDs are preferred to be done after the age of 18 yrs. especially in the posterior region due to the large pulp size or teeth are not fully erupted. They are not indicated for elderly patient when there is a lack of resilience of the

periodontal membrane or teeth attrition which increase the size of occluding surfaces.

### B- Local:

**1-** Absence of distal abutment.

**2-** A considerable bone loss in the visible area of the mouth.

**3-** Long span.

**4-** Abutment related factors (tooth not suitable as abutment: length, shape, caries, and periodontal support).

**Advantages of the bridges:** They improve appearance, function, & speech. They maintain the occlusal stability, provide periodontal splinting, and restore occlusal vertical dimension.

**Disadvantage of the bridges:** They may induce tooth & pulp damage, potential secondary caries, periodontal problem added to the high cost.

### Comparison & advantages of fixed bridges over RPDs:

**1)** More stable & comfortable because it covers less tissue surface (there is no acrylic base, flanges or clasps).

**2)** More aesthetics.

**3)** More stable occlusion with even distribution of the occlusal forces.

**4)** Provide a splinting action, while the RPDs push the teeth and cause mobility.

**5)** Easier cleaning using tooth brushes and dental floss (when there is a point contact between pontic & the underlying tissue), in contrast, the RPD must be removed to be cleaned.

**6)** Do not irritate tissues or apply pressure on them.

**7)** Psychological patients can easily tolerate FPD rather than removable one.

**8)** The FPDs are preferred for handicapped, epileptic patients, and patient with Parkinson disease due to the possibility of fracture or inhalation of the RPD.

**9)** No speech difficulty in FPDs

**10)** Badly tilted abutment teeth may interfere with the construction of PD (due to the presence of undercut that lead to food stagnation). A telescopic bridge with metal coping, or fixed-movable bridge or proximal half-crown can be used.

**11)** Anatomical limitation of RPDs such as abnormally large tongue, muscular disorder, mandibular tori (torous), and palatal surface tissue.

## Classification of dental bridges (Types of bridge):

### A. Depending on the materials used

**1.** Cast metal FPDs

**2.** Metal-ceramic FPDs

**3.** All-ceramic FPDs

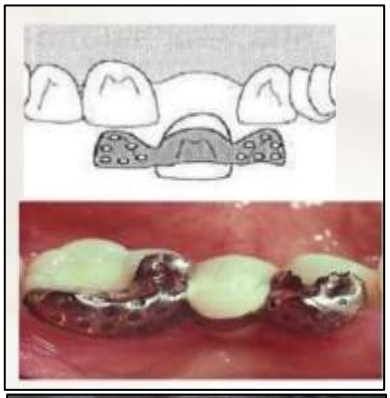
**4.** Resin-veneered FPDs

**B. Depending upon location:** Anterior FPDs, and posterior FPDs

**C. Depending on number of teeth:** Two units FPDs, Three units FPDs.

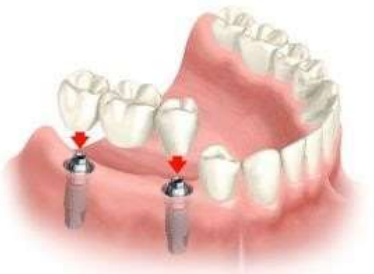
## D. Depending upon the tooth reduction


1. **Conventional** (Conventional preparation) bridges: where a substantial tooth reduction is necessary for the abutment teeth.



2. **Minimally-prepared bridges**: (adhesive, acid etched, resin-bonded bridge): These bridges are luted to the unprepared or minimally prepared surfaces of the abutments with resin adhesives.

3. **Hybrid bridges**: A combination of conventional & minimally prepared teeth. The figure shows a Fixed-movable with a minimal- retainer carrying the movable connectors



4. **Implant-Supported FPDs**: Bridges that are totally supported by implant fixers, usually are not attached to the adjoining natural teeth, which are either can be removed by the dentist only, or can be removed by the patient for cleaning or any other reasons.

5. **Removable bridges**: Bridges that are totally supported by teeth which differ from the RPDs. They are either be removed by the dentist only, or can be removed by the patient for cleaning or any other reason. They are designed to overcome problems associated with long span FPD, such as Andrew s bridge system that is indicated for edentulous ridges with sever vertical defect. The prosthesis consists of a fixed & a removable component

Figure 1: Preoperative and post teeth reduction for porcelain fused to metal restorations

Fig. 2: Metal try-in, and waxed up trial denture for RPD

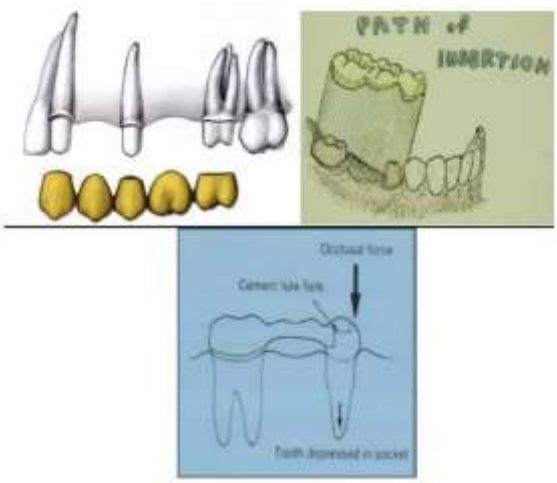
Fig 3. Post-operative Picture: Andrew's Bridge replacing

## E. Depending upon the connectors (Basic bridge designs)

### 1. Fixed-fixed bridge:

- Preferred for long-span bridges.

- Have rigid connector at both end of the pontic.
- Maximum retention & strength.
- All retainers are major which require extensive tooth reduction.
- Unconservative, more destruction of the tooth structure & trauma to the pulp
- Must have only one path of insertion (the preparations of both abutments need to be parallel).




-The entire occlusal surfaces of both abutments must be covered with retainers otherwise the occlusal forces will be directed on the unprepared area which depress the tooth downward & break the connectors.

- All retainers must have approximately the same amount of retention reducing the risk of dislodgement when the force is applied on weak retainers.

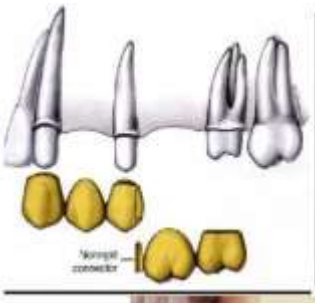
-. Abutment teeth are splinted together (adequate in case of mobile teeth).

- Cemented as one piece.

**2. Fixed- mobile design:**

- Have rigid connector (major) at the distal end of pontic & mobile (minor) connector mesially.

- More conservative to tooth structure than fixed-fixed design, because minor retainers need less tooth reduction.



- It allows minor tooth movement (lateral & vertical).

- Limited to one missing tooth (limited length of span).

- Parts of the bridge can be cemented separately.

- Lab. construction is complex & difficult.

- Preparation of abutment does not need to be parallel.

- It is indicated to be used in divergent abutment teeth (unparallel), whenever a pier abutment is present (complex bridge), and for aesthetic consideration (class III inlay on distal of canine).

**3. Simple cantilever:**

- The support for the pontic at one end only.

- Pontic may attach to one or two retainer.

- Abutment tooth is either mesial or distal to the span.

- It is the most conservative design

- Limited cases, as in lateral incisor replacement using the canine as abutment when <u>the occlusion is favourable.</u>

- The design can be used to replaced upper or lower first premolar & second molar.

**4. Spring cantilever**

-The pontic attach to a long metal arm (flexible bar) run into the palate & terminate with rigid connector on the palatal side of a single retainer on upper 4 or pair 4 & 5.

- Tooth retained and tissue borne.
- Forces are absorbed by the springing of the arm and by displacement of the soft tissue of the palate.
- The abutments are usually posterior teeth (tooth need restoration is better to be used)
- Contraindicated in V-shape palate & in the lower arch
- It is indicated only for replacing missing upper incisor when the adjacent teeth are sound, midline diastema, spacing of anterior teeth, or posterior teeth need crown.
- Not advised for the lower arch due to the instability of the sub-mucosal tissue, and a potential for plaque & calculus deposition.

**5. Combination designs (Complex or compound bridge)**

It is a combination of two or more of conventional designs incorporated in the general design of bridge, such as:

- Fixed-fixed with simple cantilever.
- Fixed-fixed with fixed-mobile.

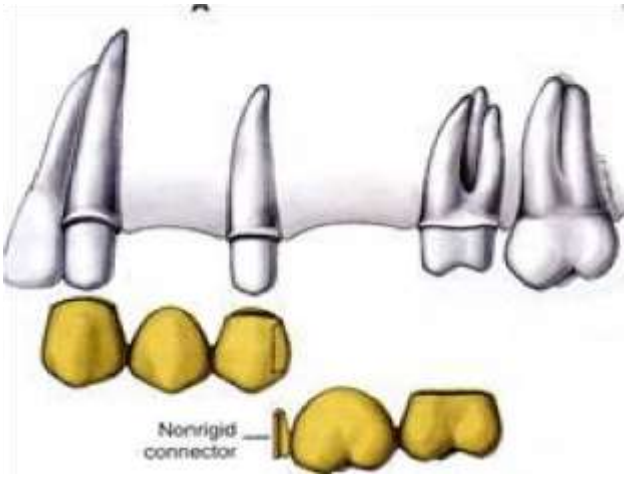
**Benefits:**

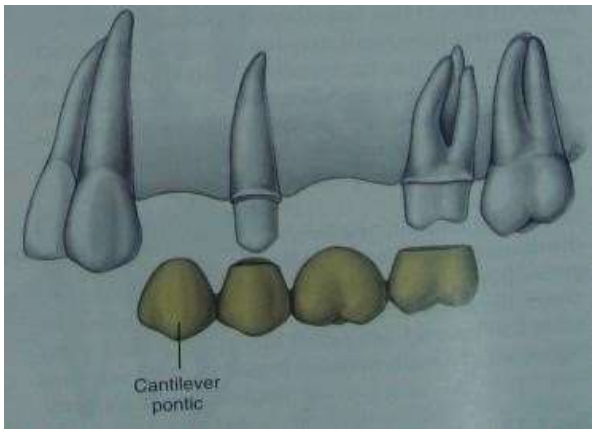
- Simplify the construction of the prothesis.
- Unfavourable angulation of abutments.

- Simplify the preparation and conserve tooth tissues.

- Easily repaired after fracture.

- Precision retainers permit the separation of two or more components.




## Fluid control and soft tissue management

Complete control of the environment of the operative site is essential during restorative dental procedure. For the patient's comfort and safety, and for the operator’s access and clear visibility.

### Fluid control:

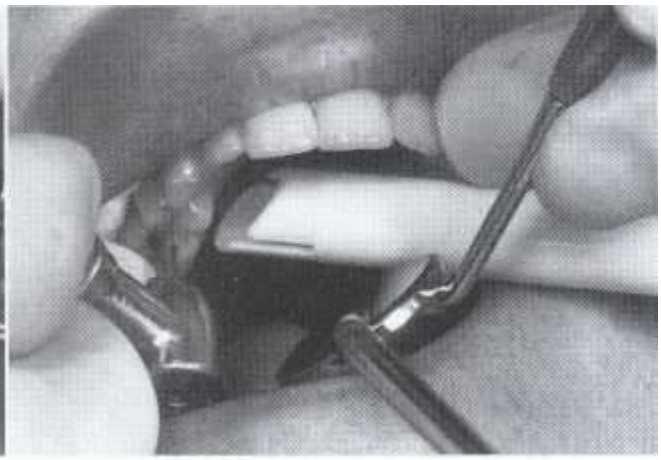
Depending on the location of the preparation in the dental arch, several techniques can be used to create the necessary dry field of operation.

#### 1- Rubber dam:

Rubber dam is the most effective of all isolation devices utilized in restorative dentistry, but it has only limited direct application in the area of cast restorations. It can be used during tooth preparation for inlays and onlays (if the occlusal reduction is done before the dam is placed).

**2- High volume vacuum:**

A high-vacuum suction type is extremely useful during the preparation phases and is most effectively utilized within assistant when wielded by acknowledgeable assistant, it makes an excellent retractor while the operator uses a mirror to retract and protect the tongue.



## 3- Saliva ejector:

The simple saliva ejector can be utilized effectively in some situations by the lone dentist. It is most useful as an adjunct to high-volume evacuation, but it can be used alone for the maxillary arch. The saliva ejector is placed in the corner of the mouth opposite the quadrant being operated, and the patient's head is turned toward it. It can also be used very effectively on the maxillary arch for impression and cementation simply by adding cotton rolls in the vestibule facial to the tooth being isolated. It can be used on the mandibular arch while cotton roll holder positions cotton rolls facial and lingual to the teeth.

# Gingival Retraction

To displace free gingival tissue or to expose the margin of the preparation, so that better impression could be taken. It is used when the margin is sub gingival or with the level of gingival.

## The objectives of the gingival retraction are:

1. Create access for the impression material to the area of preparation that is located subgingivally.
2. Provide enough thickness of the impression material at the area of the finishing line to prevent distortion of the impression.
3. Prevent sulcular hemorrhage and fluid seepage which interrupt the flow of impression material.

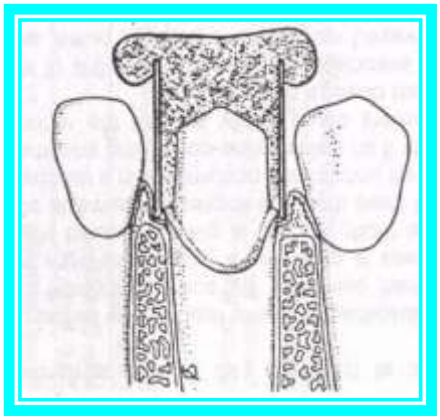
## Techniques of gingival retraction could be:

1. Mechanical.
2. Combination of mechanical and chemical (chemo-mechanical).
3. Surgical technique.

**1-** ***Mechanical***: We apply pressure on the gingival to open the gingival sulcus. May be done by:

**A**- Construction of temporary crown with long margin and leave it for half an hour. Their effectiveness is limited because pressure alone often will not control sulcular hemorrhage.

**B-** The most common way to do gingival retraction is by using retraction cord which is special cord made of cotton comes either with or without medicament (vasoconstrictor). The cord that is free from vasoconstrictor is used as mechanical technique.



**2- *Chemomechanical*:** The cord contains vasoconstrictor (adrenaline). We use it as mechanical and chemical retraction. By packing this cord in gingival sulcus, between the tooth and the free gingival tissue using plastic instrument (Ash no. 6) so that the cord physically pushes the gingival tissue away from the finish line and the combination of the chemical action and pressure packing help to control seepage of fluid from the wall of the gingival sulcus. We put the retraction cord inside the gingival sulcus all around the tooth; it is left for 10 minutes.

**3- *Radial or surgical:*** done by using electrosurgical unit to remove gingival tissues from finishing line or sometimes we do gingivectomy in case of periodontal disease or inflammation.

Reference: Contemporary Fixed Prosthodontics

# CROWN AND BRIDGE

**Lecture: 3** **Dr. Farid**

## Impression Materials and procedure

Impression: It is the negative likeness of the oral soft and hard tissue and their relationship. Because it is neither possible nor desirable to make patterns for fixed prostheses directly in the mouth, an impression is necessary to obtain a cast.

Impression can be made by placing soft or semi soft material in a tray that is inserted into the patient's mouth. When the material has set, it is removed from the mouth. The "negative" impression is filled with dental stone, and a positive likeness or working cast is obtained

### Requirements of successful impression: -

1- It must be an exact record of all aspects of the prepared tooth, including sufficient unprepared tooth structure adjacent to the finish line.
2- All teeth in the arch and tissues adjacent to the tooth preparation must be reproduced to permit accurate articulation of the cast and allow proper contouring of the restoration.
3- The impression must be free of air bubbles, tears, and thin spots especially in the area of finish line.

### Ideal properties of impression material: -

1- It must become elastic after placement in the mouth, because it must be withdrawn from undercut (that is usually exist on the external tooth surface adjacent to the preparation). So it should be able to return to its original shape after removal.
2- Must have adequate strength to resist tearing when removed from the mouth.
3- It must have adequate dimensional stability and reproduction of the details, so we have the exact negative imprint of the prepared and unprepared teeth.
4- Must have good handling and setting property that meet the dental requirement and should be free of toxic or irritating compounds.

## Classification of impression materials:

### 1- Non elastic impression materials: -

a- Impression compound.
b- Impression plaster.
c- Zinc oxide eugenol paste.

These are not used in crown and bridge work because when they set they become rigid so upon removal from undercut they will fracture. Sometimes we use impression compound for single tooth impression with copper band.

### 2- Elastic impression material: It is the type we use in our work because it is elastic after setting, so when we remove it from the undercut it will not fracture, and there will be slight deformation that it will return to the original shape.

**A- Hydrocolloid** 1- Irreversible (Alginate) 2- Reversible (Agar- agar)

1- Alginate is used to produce primary impression; it doesn't give us accurate details, so we use it to produce the study cast and articulation cast.

2-Agar-agar gives accurate details but it has low dimensional stability and needs extra equipment, so most of the dentists don't use this type of material although it has accuracy.

### B- Elastomric impression material (Rubber bases): -

1- Polysulfide polymer.
2- Silicon A- Condensation type. B- Addition type.
3- Polyether.

This type of impression set by chemical reaction. Usually supplied in different consistencies (viscosity) which depends on the amount of fillers, these are light body (syringe type), medium body, monophase (single-viscosity), heavy body (tray material), and putty

Most of the time, the heavy body is used as tray material while the light body is used with special plastic syringe to be placed on the preparation.

While the medium viscosity, is mostly used in the prosthetic work like partial denture.

### Monophase (single-viscosity) impression material

Has a higher apparent standing consistency like heavy body, and yet the same material can have sufficiently high fluidity when injected by a syringe, this material also is described as thixotropic.

*Whatever the consistency of the elastic rubber material, it is supplied as two containers or tubes (the base and the catalyst).

## 1. Polysulfide:

The first type used in dentistry.

Base: A liquid polysulfide polymer mixed with inert fillers.

Catalyst: Lead dioxide mixed with a small amount of sulfur and oil. Act as oxidation initiators.

Disadvantages:

1. Must be poured as soon as possible after taking the impression (delays of over an hour resulted in clinically significant dimensional change).
2. It has long setting time (about 10 min), induces poor patient acceptance.
3. Humidity and temperature reduce the setting time.
4. Lead dioxide (catalyst) gives brown color for the material and the material after polymerization is sticky so we should be careful in handling this material because it may stain the clothes permanently.

**2. Silicon impression material**. (Odor less /any shade / less effected by temperature)

## (I) Condensation type: -

*Base: Liquid silicon polymer with terminal hydroxyl group and filler particles.

*Catalyst: A viscous liquid consists of ethyl-silicate with organic tin as activator (tin octet).

Disadvantages:

1- Extremely hydrophobic, so it needs dry field during taking an impression and stone pouring.

2- Poor dimensional stability after setting.

Upon mixing condensation reaction take place with the elimination of ethyl alcohol and water as by-product; this is responsible for the dimensional change (Shrinkage) of the material, which result in poor dimensional stability after setting.

Both polysulfide and condensational silicon is condensation polymer.

When we take impression by this material it must be poured 1 hr after we take it.

**(II) Addition type (vinyl polysiloxan silicon).** (Stiffer than polysulfide, greater dimensional stability)

*Base: silicon with terminal hydrogen group and inert fillers.

*Catalyst: Silicon with terminal viny1 groups, chloraplastinic acid as catalyst and other filler.

Without elimination of by-product which result in a more dimensional stable material.

## 3- Polyether Impression Material:

This material could be supplied as two-paste system of medium consistency (monophase).

Base: Polyether polymer with terminal ethylene amine group with filler.

Catalyst: Alkyl aromatic sulfonate with filler particles.

This material absorbs moisture that might result in dimensional changes. It must be kept dry after taking the impression, and some times we can pour it after one day.

It stiff material and we should be very careful when separate. We must be careful because we might break the area of the prepared tooth.

All rubber bases are hydrophobic except polyether; so moisture control is essential before taking impression.

## *General factors that affect most of elastic rubber impression material: -*

1- The rubber impression material shrinks during polymerization, so we must be sure about complete setting of the material before we remove it from the patient mouth.
2- The impression must be casted (poured) one hour after removal.
3- The rubber impression materials are most accurate when they are used in thin section and this will necessities the use of special tray when taking the impression to reduce the amount of the impression material so that we reduce the dimensional change that will occur.
4- The temperature and humidity reduce the setting time.
5- Alteration in the ratio of catalyst to base will affect the setting time of the material.
For the final impression we need special tray, special impression syringe and the impression material. The special tray is made on the study cast.

**The advantage of study cast: -**
1- Diagnosis and treatment planning.
2- Construction of temporary crown.
3- Construction of special tray.

## To have a successful impression we must have: -
1- Special tray to reduce the volume (thickness) of the impression material and so reduce distortion by reducing: polymerization shrinkage and the thermal contraction.
2- Knowledge of the physical property of the impression material.
3- Moisture control during taking the impression…
4- If it is necessary we need to do gingival retraction.

## The advantages of special tray: -
1- It allows the use of impression material in minimum thickness essential to control the dimensional changes that increase with thick section.
2- It allows more comfortable impression technique of impression taking as it reduces the gag reflex so it will reduce the discomfort of the patient.
3- The small size of the special tray prevents the forcible opening of the mouth.
4- It allows free snappy removal of the impression.

## Materials used for special tray are: -

1- Self cure acrylic.
2- Shellac base plate.
3- Thermoplastic material.
4- Photopolymerized material.
Both 2 and 3 are not rigid enough and most of the time we use acrylic to construct special tray.

## To construct special tray, we need: -

1- Pink base plate wax.
2- Study cast.
3- Acrylic.

## Construction of the special tray

We will construct the special tray on the study cast by the use of cold cure acrylic and pink base plate wax.

1. On the study cast we draw a line by a pencil around the dental arch, which is about 5mm cervical to the gingiva; this line represents the finishing line of our special tray.
2. After that we adapt two layers of base plate wax over the cast, and then we remove the wax from the periphery until we see the line that we draw.
3. Then we create holes (two posterior and one anterior) on the occlusal surface in oblique direction to obtain stoppers for our special tray then after these two layers of wax we adapt a layer of tinfoil.
4. After that we start to adapt the acrylic on the wax and we use it when it reaches the dough stage all around the layer of pink base plate wax and we remove the excess until the finishing line appears, we use the excess to make the handle and wait until complete setting, then we remove it from the cast, which will be facilitated by the layer of tin foil.

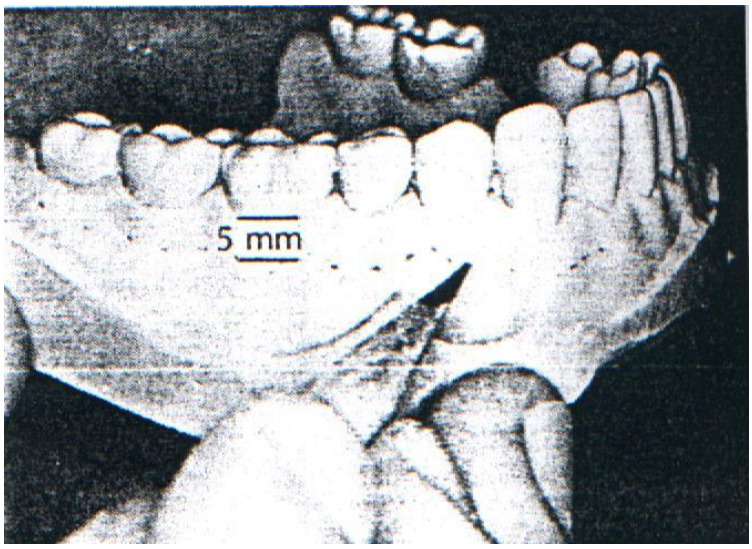
## Requirements of special tray: -

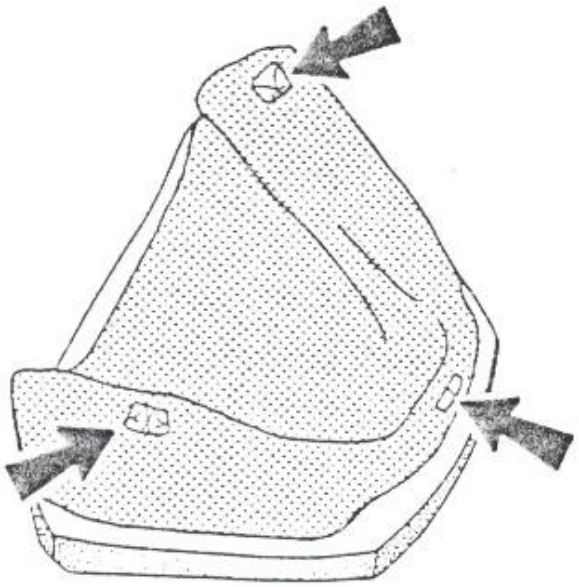
1- Must be rigid and have thickness of 2-3 mm.
2- Should extend about 5mm cervical to the gingival margin.
3- Stable in the cast with stoppers.
4- Made at least 6 hours prior to be used.

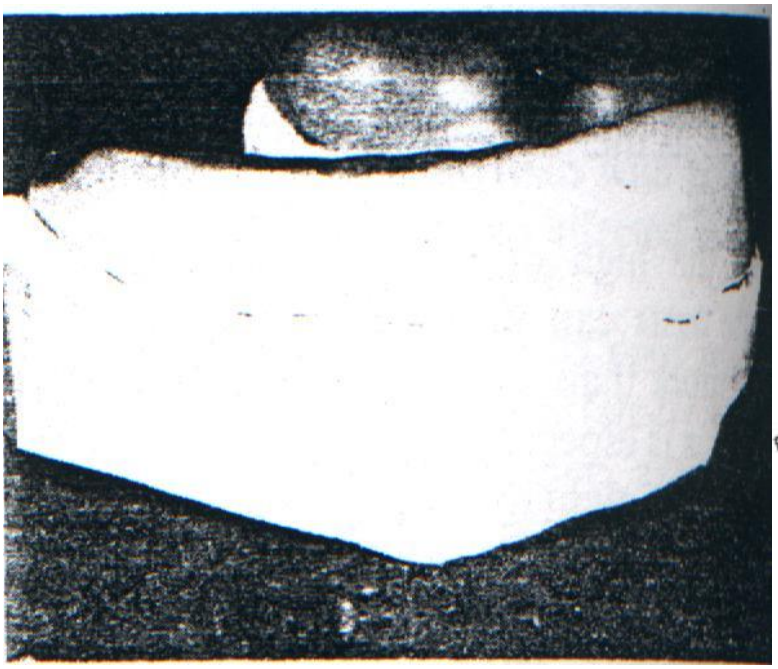
## The advantage of the stopper is: -

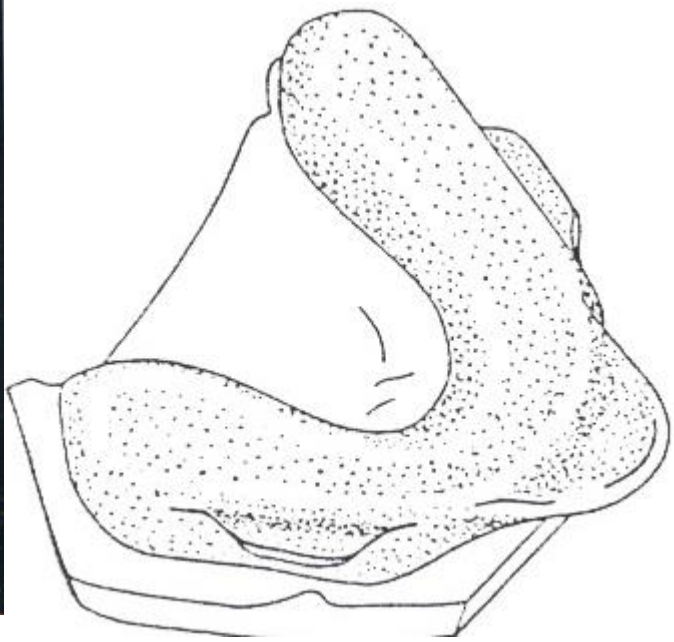
1- To equalize the pressure that is going to be applied on the tray.
2- It gives us benefits to localize our tray in the mouth during impression making.
3- Maintain even space for impression material and prevent making contact with the prepared teeth.

Now we are ready to take final impression.
For making final impression we also need special impression syringe and impression material. Impression syringe is made from clear plastic, and should be available with different nozzle sizes; we need this syringe to carry the light body material from the mixing slab to the preparation.







## IMPRESSION TECHNIQUES

1- Single stage technique.
2- Two stage technique.
3- Putty wash technique.

### *1- Single stage techniques:*

Most of the time we use this technique when we have impression material with single viscosity (mostly medium viscosity material), e.g. Polyether, after we mix the impression material part of it is loaded in an impression syringe from the mixing slab, and we place it on the special try, we inject the material over preparation. And we start with the most critical parts (Pin holes, Margins) then the preparation, and the remaining part of the dental arch.

After wards, place the special tray over the dental arch, wait for complete set then remove.

### *2- Two stage techniques*:

Used with materials that has two viscosities light and heavy. We mix the heavy and light body at the same time the heavy body is placed in the special tray; we start to inject the light body on the dental arch starting with the prepared tooth.
After we finish injecting the impression material we place the special tray with the heavy body in the patient's mouth.
The pressure exerted by heavy body will create intimate contact between light body and the prepared tooth and will make direct flow of the light body into the details of the preparation.

## Putty wash techniques:

This technique uses a high viscosity material; we start to take impression with the heavy body (before or after preparation).

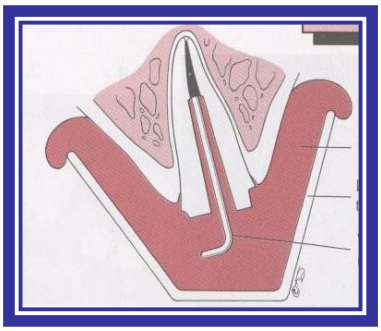
## If we make it before preparation:

We leave the impression material until it sets inside the patient mouth, and then we remove it, and do our preparation. After that we start to mix the light body and load it in the impression syringe and inject it over the preparation and the dental arch then we reseat the tray inside the patient mouth and wait until setting occurs.

## If we make the impression after preparation:

We use it with spacer made of polyethylene materials placed over the heavy body and inserted in the patient's mouth and wait until setting then remove the polyethylene (spacer). After that we complete the steps of light body application and impression taking.

* All techniques can be used in any type of preparation but it depends on the material. When we take impression for post crown we need impression for the root canal space so the impression inserted inside the tiny canal and even when it fills the canal it might tear off or distorted during pouring the die materials (stone). So the impression material need a type of reinforcement either by a plastic post or by stainless wire placed before setting, the impression will not be torn or distorted because it is not movable.



We shall make the surface of the wire rough by burs in order not be pulled away from the impression.

## After taking the impression we should inspect the impression for the following points: -

1. Finishing line in the impression must be continuous from one surface to the other.
2. No air bubbles present on the surface of the impression especially at the area of finishing line.
3. The attachment of the impression to the tray must be firm (major difference among impression materials that every one has it is own adhesive that used to bind it to the special tray).

Reference: Contemporary Fixed Prosthodontics

# CROWN AND BRIDGE

Lecture: 4 Dr. Farid

## PROVISIONAL RESTORATION
(TEMPORARY RESTORATION)

It's important that the prepared tooth or teeth be protected and that the patient is kept comfortable while a cast restoration is being fabricated.

**A good provisional restoration should satisfy the following requirements:**

1. Pulpal protection: It should prevent the conduction of temperature extremes and the margin should be well adapted to prevent leakage of saliva.
2. Positional stability: The tooth should not extrude or drift in any way.
3. Occlusal function: Being able to function occlusally on the provisional restoration will aid patient comfort and also prevent tooth migration.
4. Easily cleaned: This will help the gingival tissue to be kept healthy and reduce post cementation problems.
5. Non-impinging Margins: it is of the utmost importance that the gingival margins of the provisional restoration not impinge upon the gingival tissue. The resultant inflammation could result in hypertrophy, gingival recession, or at the very least gingival hemorrhage during cementation.
6. Strength and retention: The restoration must stand up to forces that it's subjected without breaking.
7. Esthetic: In some cases, they must provide good cosmetic results.

***Types of provisional crowns:***

## I- Ready made crowns:

### *1. Metal crowns:*

Mainly used for posterior teeth. They are made of stainless steel, nickel chromium or aluminum and the last one is the most useful because it's soft

The metal crowns are of 2 types:

- Flat topped cylindrical types.
- Morphologically contoured type.

***Disadvantages include:***

*1*- Unpleasant taste.
2- Unacceptable esthetic.
3- Rapid weariness of the crown.

***Clinical procedure:***

- Select the proper size and shape of the provisional crown.
- Trim the margin to be fit to the finishing line and to accommodate the vertical height of the prepared tooth.
- Seat the crown over the tooth and check the margins and the occlusion.
- Smooth the margin with a stone bur.
- Cementation with ZOE in the abutment.

### ***2. Celluloid crown forms:***

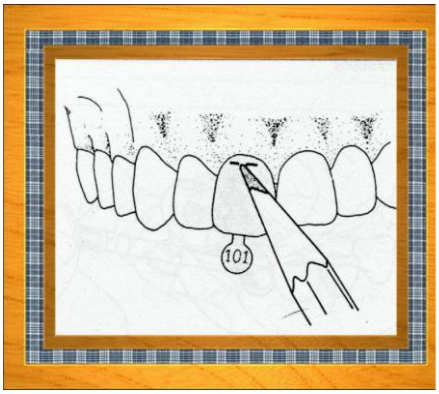
It's mainly used for anterior teeth, but can be used for posterior teeth also.
It acts as a mould for construction of provisional restoration.

### ***Clinical procedure:***

Coat the tooth after preparation with Vaseline to facilitate removal of the crown. Make 2 holes in the in the corners of the crown to facilitate the removal of the excess material then we cut it to the same margin of the tooth. Then fill the mold with provisional crown materials with same shade of the tooth; then place it over the tooth, until set. (If the material is exothermic, you have to remove it from the tooth at the simplistic stage so the final polymerization occurs outside the mouth)
After that take it out and remove any excess material and then replicate on the tooth and check occlusion, contact points, fitness and extension. Then polish it and temporally cements it.

### ***3. Acrylic ready-made crown:***

It's mainly used for anterior teeth. It is supplied with different sizes and shades.
After choosing the proper size and shade the procedure is similar to that of Aluminum crown.

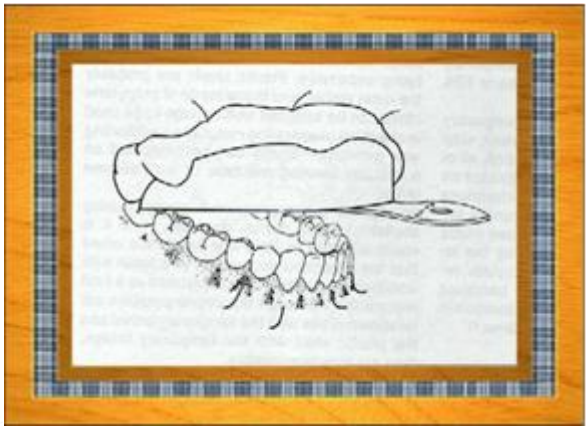


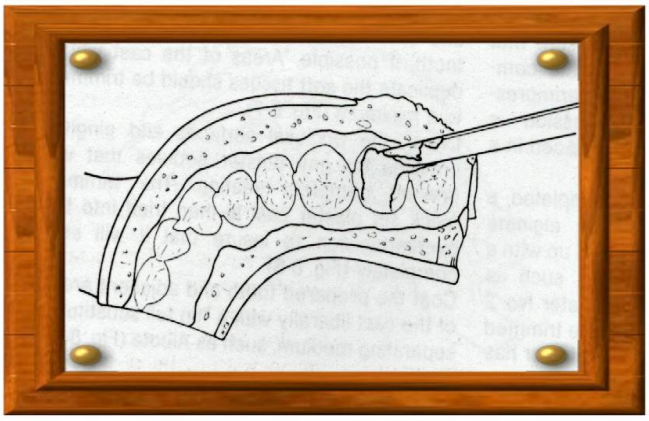

## II- custom made provisional restoration:

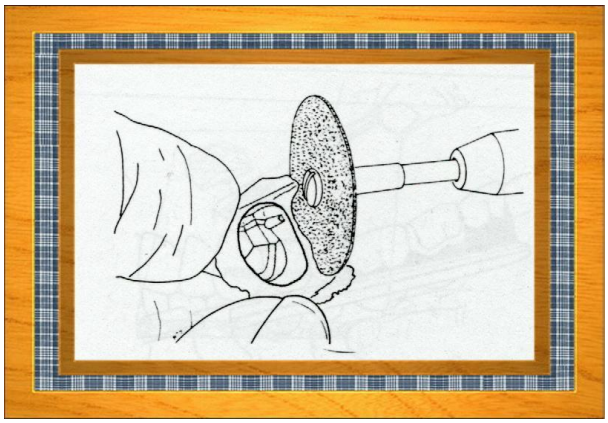
Direct and indirect construction of crown and bridge.

## A) Direct impression method:

- A preoperative impression with alginate or silicon rubber base is made and stored until complete preparation is made.
- Coat the tooth with separation medium.
- Mix the provisional crown and bridge acrylic and load the tray on the position of the prepared tooth only and insert it inside the patient mouth.







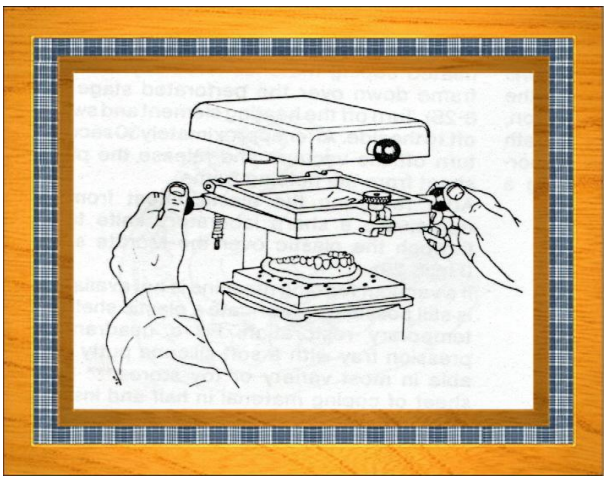
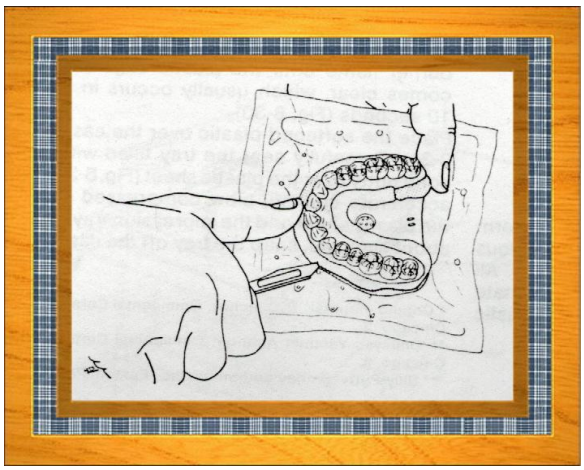
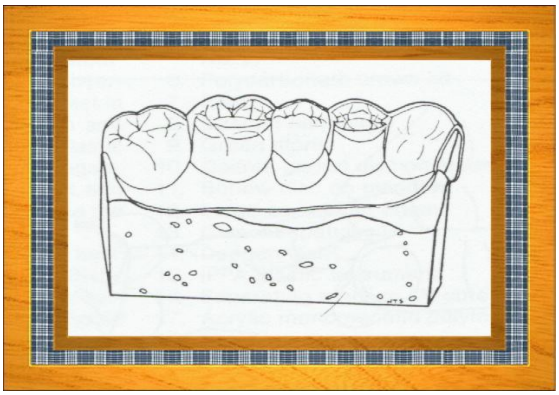
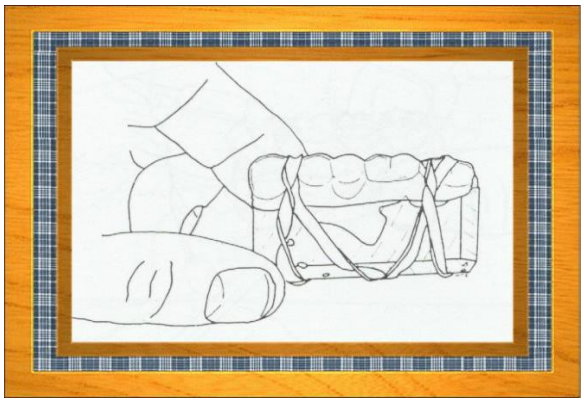
- After complete polymerization (if the reaction is exothermic you have to take it out from the patient mouth before that), the formed crown is removed and any excess material is removed and we check occlusion and the margin, then cementation by temporary cement.

## B) Indirect method:

To prevent tooth irritation, we can take 1 preoperative & 2 postoperative impression.
One of them pours it with quick set stone.
After it sets remove the cast & repeat the same steps of direct method on the cast after putting separating medium.
a) No heat and monomer to the tooth.
b) Better margins.
c) Less chair time.

## Custom provisional bridge:

When a bridge is to be made, the provisional restoration should also be in the form of a bridge rather than individual provisional crowns.
A preoperative cast is prepared, we put a partial denture tooth in the edentulous area; and then by using a thermal vacuum machine, template celluloid acetate is made as a mold to fabricate the provisional bridge.
The celluloid is 3-4 mm in thickness; it's heated and then placed over the cast and pulled by vacuum over the cast to take its shape.
Then we cut this sheet keeping half a tooth from each side to act as a stopper and 0.5 mm below the margin. Then we load it with the auto-polymerizing resin, place it on the teeth after coating with Vaseline and ask the patient to bite.
After setting remove any excess and temporary cement it.

## Provisional post crown tech.

## Preformed:

Ready-made provisional crown having a post inside. So you can trim and adapt them to be seated on the prepared tooth.

## Custom made:

This can be accommodated for in the use of a standard acrylic crown by placing a piece of a paper clip or other wire into the canal and placing the acrylic filled crown; down over that. After setting you can remove it with the wire attached, and then cement it.

## ***Temporary cement:***

A wide variety of temporary cements are available; most of them based on zinc oxide and eugenol.

Reference: Contemporary Fixed Prosthodontics

# CROWN AND BRIDGE

**Lecture: 5** **Dr. Farid**

# BITE REGESTRATION AND ARTICULATION

To fabricate fixed partial denture according to the patient's occlusion, the working cast plus the opposing cast should be mounted to an articulator.

## Interocclusal record (bite registration):

To transfer the relation between the upper and the lower dental arch from the patient mouth to the articulator we need bite registration.

Proper interocclusal record is important to orient the die or dies of the same arch to the opposing arch.

When enough teeth are present in both upper and lower arches we can transfer the relation by hand articulation of the cast. (No bite record is needed in such case). So we can occlude the opposing casts by hand then mount them on the articulator, however, if the remaining teeth are insufficient to produce hand articulation of the cast we have to record the bite by:

**1- Pink base plate wax.**

**2- Bite registration paste.**

**3- Bite rim or occlusal rim.**

### How to record?

Whatever the material used to record the relation, you have to guide the mandible to the required relation (centric or eccentric).

## JAW MANIPULATION

Accurately mounted casts depend on precise manipulation of the patient's mandible by the dentist.

The Bi-manipulation Technique is recommended as a reproducible technique in this technique, the dental chair is reclined and the patient's head is cradled by the examiner. With the both thumbs on the chin and the fingers resting firmly on the inferior border of the mandible, the examiner exerts gentle downward pressure on the thumbs and upward pressure on the fingers, manipulating the condyle-disk assemblies into their fully seated positions in the mandibular fossae. Next, the mandible is carefully hinged along the arc of terminal hinge closure. The most widely used material to record the occlusal relation pink base plate wax.

Then the record is taken by softening the wax at first, then applies the soft wax over the occlusal surface of the prepared teeth, then, ask the patient to bite on it, keeping in your mind that you have to guide the mandible of the patient to the reference point that you mark it, to have the correct registration.

The patient is asked then to mold the wax at the lingual area by his tongue, while by your finger adapt the wax on the labial side. After complete setting remove it from the patient mouth, trim the excess and attach it to the cast and transfer it to the articulator.

**Bite rim:** used if we have free end saddle, in this case there are insufficient teeth to provide bilateral stability, obtaining a centric record as described may not be possible. As a result, acrylic resin record bases must be fabricated. To avoid errors caused by soft tissue displacement. So we use

bite rim over the record base to record the centric relation (the same as that used for removable partial denture).

**Articulator selection**

Handheld casts can provide information concerning alignment of the individual arches but do not permit analysis of functional relationships. For an analysis, the casts need to be attached to an articulator.

- It is a mechanical device that simulates mandibular movement. Articulators can simulate the movement of the condyles in their corresponding fossae

**CLASSSIFICATION OF THE ARTICULATORS**

They are classified according to how closely they can reproduce mandibular border movements. The aim is to create fixed partial denture in functional harmony with the patient's occlusion, also less time will be needed for adjustments at delivery

Small nonadjustable articulators (simple hinge articulator)

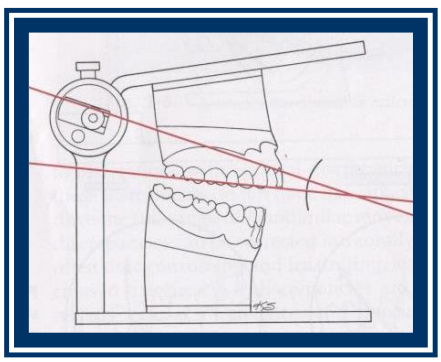
- Permit hinge opening only.
- Some types provide very limited lateral movements.
- The distance between the teeth and the axis of rotation is shorter than in skull, loss of accuracy**.**

Semi adjustable articulator
Used for most routine fixed partial dentures.
They are about the same size as the anatomic structures they represent.

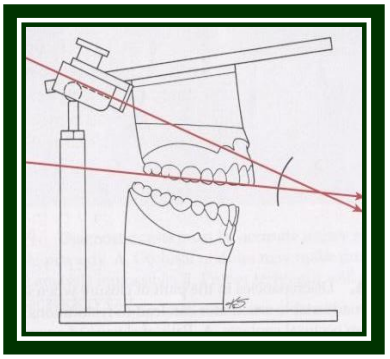
## Semi adjustable articulator classified into:

**A- NONARCON DESIGN**.

- Mostly used for complete denture.
- The condylar elements are placed on the upper portion of the Articulator. As consequences of their design, certain inaccuracies occur in cast restorations.



**B- ARCON DESIGN**



- The condylar spheres are attached to the lower component of the articulator and the mechanical fossae are attached to the upper member of the instrument. Thus, the arcon articulator is anatomically correct, which makes understanding of mandibular movements easier
- The angulations of mechanical fossae are fixed relative to the occlusal plane of the maxillary cast

•The Mechanical fossae can be adjusted to mimic the movements of the mandible through the use of inter occlusal Records.

**FULLY ADJUSTIBLE ARTICULATOR**

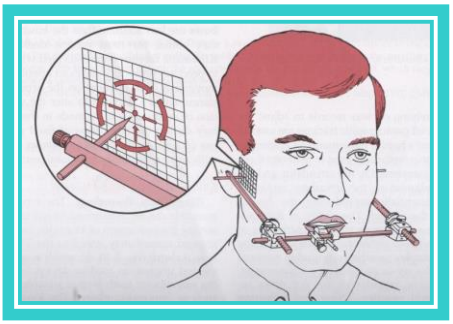
- Give a wide range of positions that can be set to follow the patient's border movements of mandible.
- Require skill and understanding from both dentist and technician.
- Useful in treating complex cases such as full mouth rehabilitation and abnormal jaw movements.
- Can accept kinematics hinge axis face-bow.
- Can register Bennett angle and side shifts of mandible.
- Rather than relying on wax records to adjust the articulator, special pantographic tracings are used to record the patient's border movements in a series of tracings.

## Face-bow

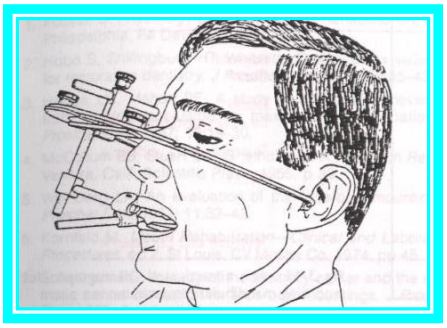
- It is a rigid caliper-like device that used for:

1- Locating the condylar axis.

2- Relating the maxillary cast to the same axis on the articulator that is present in the skull.



There are two types of Face-bow:



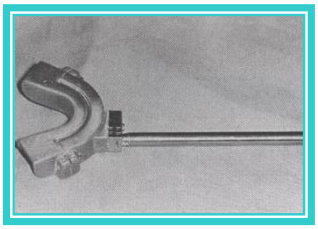
**1- Arbitrary Face-bow**

**2- Kinematic Face-bow**

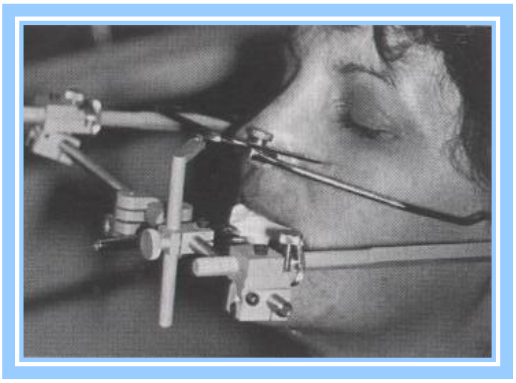
The main difference between them lies in the accuracy in locating the condylar axis. The arbitrary type provides an error of about 5mm between the true hinge axis and an easily identifiable landmark, usually the external acoustic meatus.

The kinematic type is more accurate and can determine the location of the mandible.

The Face-bow of:



A clutch (an impression tray-like metal device) attached onto mandibular arch using heavy body silicon impression material. The Face-bow is fastened to the clutch and adjusted so that its styluses could be positioned lateral to the TMJ's in close proximity to the patient's skin in order to locate the terminal hinge axis during opening and closing of patient's mouth.



Reference: Contemporary Fixed Prosthodontics

# Crown & Bridge

**Lecture: 6** **Dr. Farid**

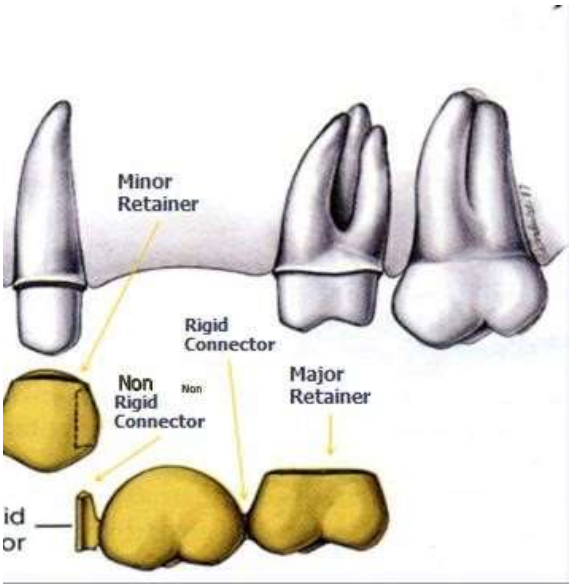
## Fixed Partial Denture (Bridge) Components:

## Bridge Retainer:

That component of FPD which unites the abutment to the remainder of restoration takes support from the abutment tooth and provides stabilization & retention to the prosthesis. It could be seat over (on or in) the abutment tooth, connecting the pontic to the abutment. Bridge retainer could be divided into:

**1.** Major retainer: Which are all these used in fixed-fixed, spring, and cantilever bridge. Fixed-mobile Bridge has one major retainer at one end of the pontic. Major retainer preparation must be retentive & with conventional bridge must cover the whole occluding surface of the tooth. (rigid connec.to pontic)

**2.** Minor retainer: Represent the lesser retainer of fixed-mobile bridge into which a movable connector from a pontic seated or attach. It doesn't need full occlusal coverage. (flexible connec. to pontic)



**Types of retainers:** Major or Minor Retainer Designs:

**1.** Based on preparation design

1) Extra coronal retainer (complete crown, partial crown)

2) Intra coronal (Inlay, onlay).

3) Intra radicular (Post & core).

**2.** Based on material used

1) All metal retainers.

2) Metal ceramic retainers.

3) All ceramic retainer.

4) Zirconium retainers.

5) Acrylic retainers.

All metal retainers are most conservative, the simplest, & the least expensive to produce. Most of the time they used in posterior region when the esthetic is not critical or patient does not mind about appearance. Metal ceramic, All Ceramic and Zirconium are used for replacement of anterior teeth where esthetic is critical. Acrylic retainer used with temporary bridge.

## Criteria for choosing suitable retainer (assessment factors):

1) Alignment of abutment teeth.

2) Retention required.

3) Appearance (esthetic).

4) Condition of abutment teeth.

5) Periodontal condition.

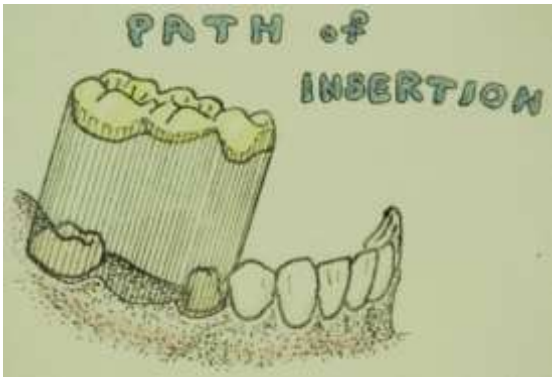
6) Conservation of tooth structure.

7) Cost.

8) Caries susceptibility.

**1.** Alignment of abutment teeth:

When abutment teeth are more or less parallel to each other, either complete or partial crown retainer can be used. If abutments are not parallel, complete crown retainer with common path of insertion cannot obtain without a destructive reduction of the abutment.




**2.** Appearance (Esthetic):

The esthetic of retainer must be acceptable to the patient. If esthetic is critical, P.F.M, All Ceramic, Zirconium or ¾ crown may be used also some patient may worry about metal display on occlusal surface of posterior teeth, this need to have porcelain extend to cover occlusal surface of metal. This lead to destructive preparation which is not always possible or desirable.

**3.** The condition of the abutment:

Partial crown cannot be used because of presence of a caries or large restoration involving the buccal surface or because of loss of buccal surface due to fracture, in such cases a complete crown is used. Pulp condition plays a vital role in the selection of retainer design, incisal relationship has great effect especially when clinical length of the crown is short for both anterior & posterior teeth (worn teeth).

**4.** conservation of tooth structure:

Inlays, Onlays are more conservative than Partial coverage which is more conservative than Complete coverage, Full Metal more conservative than P.F.M. which more conservative than All Ceramic crown. So when we have sound buccal enamel and dentine, Partial coverage is indicated to more conservative preparation. This will not only reduce the effect of cutting procedure on the pulp & periodontium, also will not destroy the natural appearance. However, if there is sound indication for complete crown, this should be done.

**5.** Cost:

Partial Crown & Complete Crown (Retainer) may be less expensive than P.F.M., which is less expensive than All Ceramic or Zirconium Crown (retainer). Metal Retainer are least expensive. When there is no other factor affecting choice, this is obviously of considerable importance.

**6.** Size and position of the abutment:

Partial crown need sufficient large and long tooth. Position may affect esthetic.

**7.** Caries susceptibility:

Patient with poor oral hygiene is indicated for complete crown.

**8.** Retention required:

The retention of a bridge retainer should be at least as great as for similar restoration made as single unit. Retention of crown vary according to preparation feature, Crown material properties and type of luting cement.

## Factors affecting the amount of required retention:

**1)** Length of span & rigidity:

The longer the span the greater the stresses on the retainer & the more will become un cemented. Furthermore, the casting will be more liable to flex, so you must be certain they are sufficiently rigid (The longer the span, the stronger must be all the component bridge).

**2)** Type of bridge:

Certain types of bridges induce greater stresses on the cementing media of bridge retainer than other. Thus strong retainers are required fixed-fixed than fixed-mobile bridge. Indeed, little retention is needed for the minor retainer of fixed-mobile bridge design. Thus when it is desirable to preserve tooth tissue, the fixed-mobile design is normally indicated as for lighter retainer can be used. For example; replacement of upper 4 by fixed-mobile bridge using 3/4 crown or fully coverage on upper 5 as major retainer & a class III inlay on the distal of canine as the minor retainer. Such design will be: Conservative, esthetic and the incisal edge not included.

**3)** Strength of the bite:

The strength of the bite determines to large extent the degree of retention required to resist it, this will vary with age, sex, & muscular development of the patient concerned. The heavier the bite the stronger & thicker the retainer material needed to prevent failure of the retainer or pontic.

**4)** Tooth or teeth to be replaced:

The size & position of the pontic have direct effect on the type of retainer required (stress amount). Thus the replacement of a molar cause greater stress to the abutment than lower incisor. Also forces acting on canine are more likely than that acting on an incisor.

**5)** Occlusal coverage:

There are several reasons for full occlusal coverage, it is always (nearly) indicated because:

a) It gives abutment complete protection during mastication.

b) There is no fear of cusp fracture (M O D inlay, or endo. Treated teeth). Full occlusal coverage always indicated in fixed-fixed bridge. Occlusal reduction must be sufficient to provide enough thickness for material to be rigid.

**6)** Habits of patient:

Various habits might induce stress on the bridge retainer such as pipe smoking, clenching; most important is grinding in Bruxism. So if large number of patient natural teeth is severely worn, then any metal occluding surface that use in retainer construction will similarly worn unless the habit can be corrected. Therefore, retainer must be thicker & stronger than normal (very hard alloy lead to wear off does not proceed at the same level as natural teeth do).

## Requirements of ideal retainer:

**1)** Provide maximum retention.

**2)** Give maximum esthetic.

**3)** Preserve vitality of preparation tooth.

**4)** Need conservative preparation (less amount of traumatic reduction).

**5)** Biologically accepted to the surrounding tissue.

**6)** Withstand masticatory forces.

**7)** Easily constructed.

Major or Minor Retainer Designs:

**1)** Extra coronal retainer (complete crown, partial crown)

**2)** Intra coronal (Inlay, onlay).

**3)** Intra radicular (Post & core).

Specific Retainer design;

 Standard

Full Metal Crown, 3/4 Crown, 7/8 Crown, Post Crown, PFM, full Zirconium.

 Non Standard

Implant, Inlay, Onlay, All Ceramic, Resin Bonded (Maryland Bridge).

## General factors in tooth preparation:

In order to obtain these ideal retainer requirements as far as related to tooth preparation, if the case permit, the design of the preparation of abutment tooth for a metal or porcelain crown restorations are limited by five principles:

**1.** Preservation of tooth structure.

**2.** Retention and resistance from.

**3.** Structural durability of the restoration.

**4.** Preservation of periodontium.

**5.** Marginal integrity.

## Factors affecting retention and resistance of crown restorations:

**1)** Taper of the preparation.

The more nearly parallel the opposing walls of preparation the greater will be the retention. 5 to 6-degree convergence angle is mostly used to provide the needed retention.

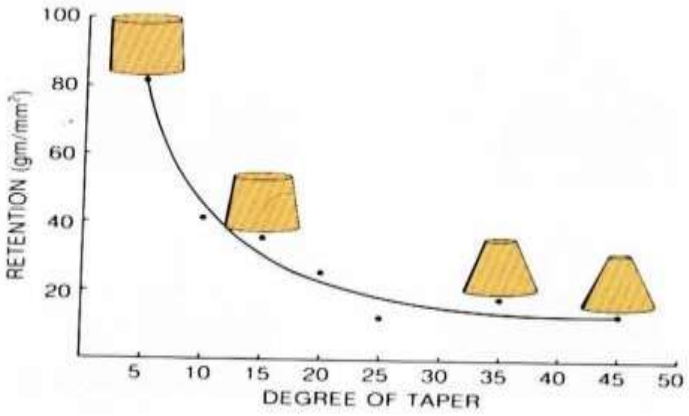
**2)** Surface area of the preparation.

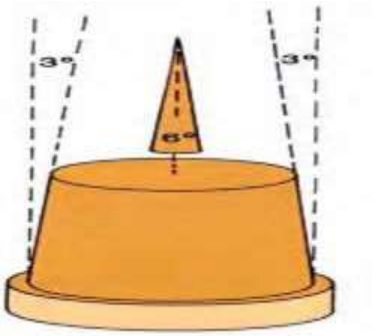
**3)** Length and height of the preparation.

**4)** Diameter of the tooth (tooth width).

**5)** Texture of the preparation.

**6)** Accessary mean.




## Structural Durability:

The preparation must be designed so that it provides S.D. to the restoration i.e. the crown restoration must be rigid enough to not flex, perforate or even fracture. For restoration to be rigid it needs enough bulk to provide to the crown restoration so sufficient tooth structure must be removed from the prepared tooth to create enough space. By doing so the restoration allowed to withstand the forces of occlusion, prevent wearing holes in the gold and allow proper contouring and carving of anatomy in the restoration.

## Preservation of periodontal tissue:

1- Whenever possible the margin of the preparation should be supragingivally.
2- The casting should have proper contact, Embrasure form, Occlusion and a healthy occluso-gingival contour.

## Margin(F.L.) placement:

Finishing line can be placed either:

1. Supra-gingival:

Placing the margin above the gingival tissue for these reasons: -

a- can easily prepared and finished.

b- to provide good vision for the dentist during preparation.

c- impression can be easily made.

d- the patient can keep the area clean easily.

e- most of the time such position is situated on hard enamel.

f- Less destructive.

The factors that influence such position of finish line are: -

a- When the esthetic is a factor.

b- When we need extra retention.

c- When we have carries or filling at the area of finish line.

2. Sub-gingival:

Placing the margin below the gingival tissue.

3. Placing the margin within the level of the gingiva.

## Marginal Integrity:

The restoration can survive in the biological environment of the oral cavity only if the margins are closely adapted to the CSL OF the prep. The configuration of the F.L. determines the shape and the bulk of the restoration margin that affect both marginal adaptation and the degree of seating of the restoration. The restoration margins should:

a- They must fit as closely as possible against the finishing line of preparation.
b- They must have sufficient strength.
c- Whenever possible they should be placed in an area where the dentist can finish and clean them properly.

## Finishing line of the preparation:

Requirement of F.L.:

**1.** It must be clear, smooth and well defined.

**2.** It must be continuous from one surface to the other.

**3.** It must lie on sound tooth structure.

Factors affecting selection of F.L. design:

**1)** Type of the restoration.

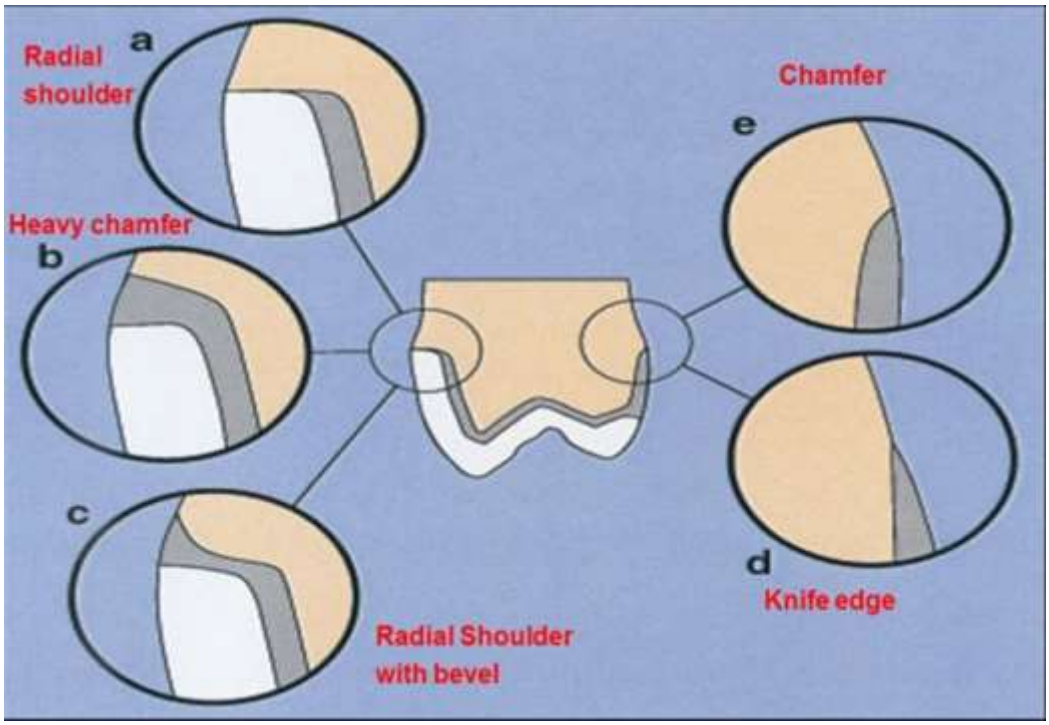
**2)** Materials used in construction.

**3)** The amount of occlusal force (stress) the restoration will bear.

Types (design or configuration) of finish line:

The following designs for finish line (margin of preparation) could be used: depending on the type of the crown restoration:

1. Knife edge 2. Shoulder 3. Shoulder with bevel 4. Radial shoulder
5. Chamfer 6. Heavy chamfer




## Complete Cast Crown (FMC)

It is one of the most commonly used retainer for the posterior teeth. Because it made of metal, it should be used when the patient doesn't mind the appearance of metal or when esthetic not a factor. This type of retainer provides better retention and resistance because all the axial surfaces of the teeth are including in the preparation.

**Indications:**

**1)** It is indicated when the bridge located posteriorly.

**2)** The abutment teeth with extensive tooth destruction as a result of caries or trauma.

**3)** As a retainer on teeth receive clasp.

**4)** Existing previous restoration that precludes the use of a more conservative restoration

**5)** Need for superior retention and strength.

**6)** Endodontically treated tooth.

**7)** Patient with high caries index.

**Contra-Indications**:

**1)** When the abutment teeth located in the appearance zone.

**2)** Patient with low caries index.

**3)** Whenever a more conservative retainer is feasible

**Advantages:**

**1)** Provide greater retention and resistance

**2)** high resistance to deformation (Strong)

**3)** Less tooth structure is removed and easy to prepared (conservative).

**4)** Strong even in thin sections

**Disadvantages:**

**1)** Poor esthetic.

**2)** Difficulty to test the vitality of the abutment tooth especially by electrical pulp tester.

**3)** Interfere with taste.

**4)** Tarnish and corrosion so it needs prophylactic measures.

## Porcelain Fused to Metal:

The most widely used retainer when esthetic is a factor. This type has the strength of F.M.C. and esthetic of All ceramic crown.

**Indications:**

**1)** Use when the abutment teeth located in the appearance zone.

**2)** Excessive retention and resistance is needed.

**Contra-Indications:**

**1)** Large pulp chamber.

**2)** Intact buccal wall.

**3)** More conservative retainer can be used.

**Advantages:**

This type has the strength of F.M.C. and esthetic of All ceramic crown.

**Disadvantages**:

**1)** Removal of substantial tooth structure.

**2)** Subject to fracture because of brittle nature of porcelain.

**3)** Shade selection can be difficult.

**4)** Inferior esthetic compared to All Ceramic Crown. 5) More expensive.

## All Ceramic Crown:

Since it made entirely from ceramic substance the most esthetically pleasing retainer. Because, there is no metal understructure to block light transmission, it can resemble natural tooth in term of color and translucency than can any other restoration.

**Indications**

**1.** High esthetic requirement.

**2.** Considerable proximal caries

**3.** Endodontically treated teeth with post & core.

**4.** Incisal edge reasonably intact.

**5.** Favorable distribution of occlusal load.

**Contra-Indications:**

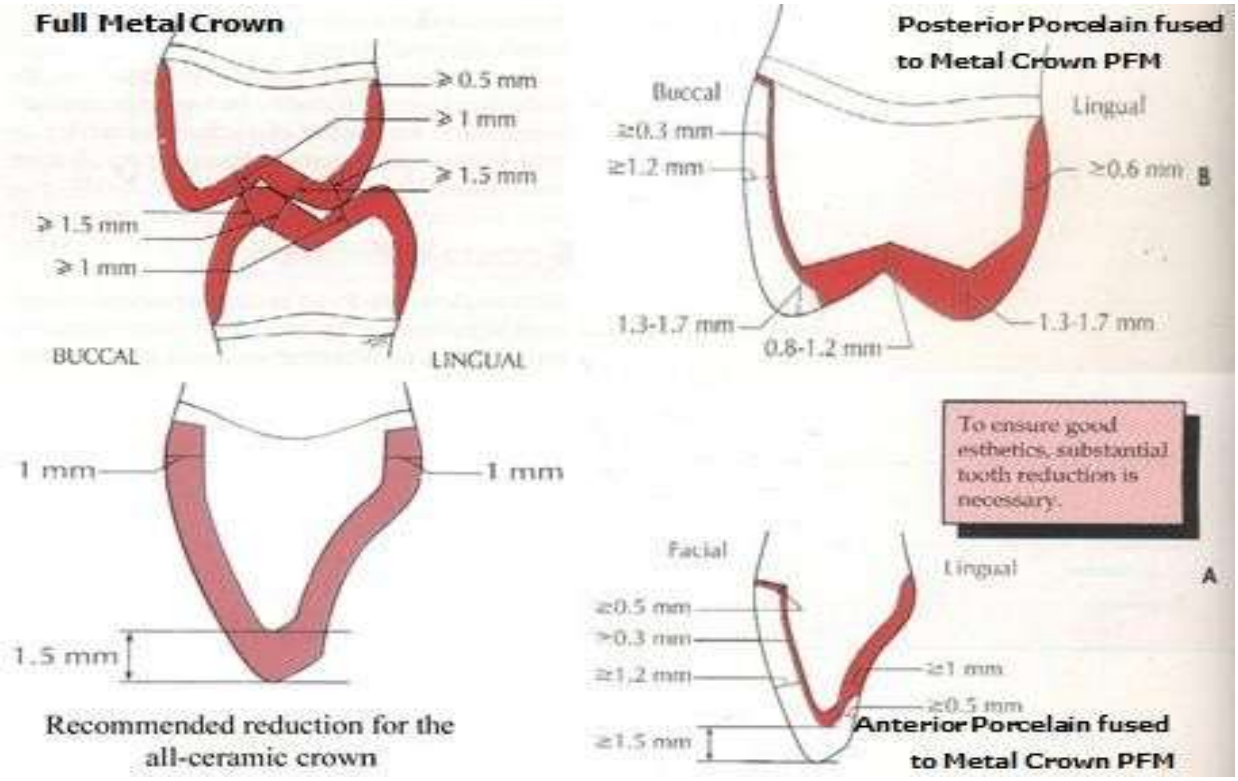
**1)** Superior strength requirement.

**2)** Thin teeth faciolingually.

**3)** Unfavorable distribution of occlusal load.

**4)** Insufficient coronal tooth structure.

**5)** Bruxism.




## Partial veneer crown (three quarter crown):

It's a cast restoration which cover 3/4 of the clinical crown (occlusal, incisal, lingual and proximal surfaces) leaving the buccal or labial surface untouched. It has less retention and resistance to displacement compared to full metal, full veneer with facing.

**Indications:**

**1)** Short span bridge.

**2)** On teeth with clinical crown of good (average) length and thickness labio-lingually.

**3)** Patient with good oral hygiene and low caries index.

**4)** When the abutment tooth in good axial relationship to facilitate the path of insertion.

**Contra-indications:**

**1)** Short teeth.

**2)** Poor O.H, grossly caries teeth.

**3)** Long span bridge.

**4)** Poorly align abutment (poor axial relationship).

**5)** Endodontically treated teeth.

**Advantages:**

**1)** Conservation of tooth structure (Tooth structure is saved).

**2)** Better esthetic than other types.

**3)** Reduced pulpal and periodontal insult during tooth prep.

**4)** Less chance of periodontal irritation because all the margins of the crown are superagingival.

**5)** Vitality tests can be done on the exposed labial or buccal surface of the tooth.

**6)** Improved access for finishing by dentist & oral hygiene by patient.

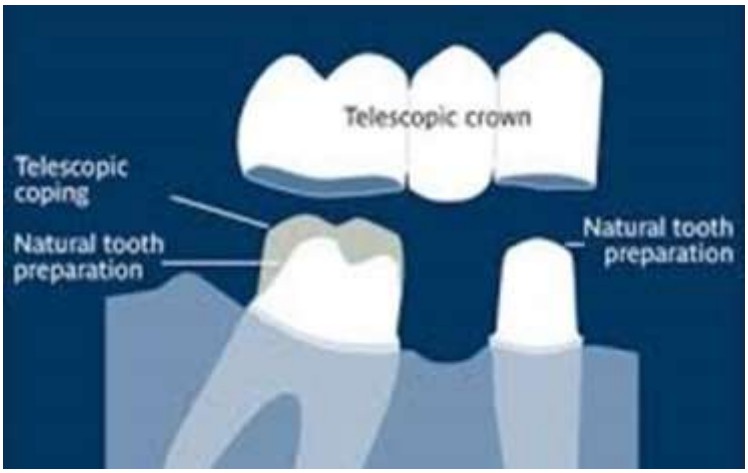
**Disadvantages:**

**1)** Possibility of recurrent caries along to cavosurface line angle.

**2)** Possibility of showing gold especially in the lower anterior and posterior teeth.

**3)** Difficulty in preparation compared to other types of crowns (limited adjustment can be made in the path of placement).

## Telescopic retainers




- Design involves fabrication of two copings one over the other
- Internal or primary coping function to modify the morphology of tooth – path insertion changed
- Secondary or external coping designed to fit over primary
- Used when path of insertion of FPD does not coincide with long axis of abutment

## Post crown:

It is a fixed artificial restoration which replaced the coronal portion of the natural tooth completely. It retained itself by a mean of post (dowel) that extended and cemented to the root canal space of endodontically treated tooth. The post crown will reinforce the remaining tooth structure against forces by distributing the forces to the supporting tissue.

**Indications:**

**1)** It commonly indicated for endodontically abutment tooth.

**2)** Abutment tooth with short clinical crown.

**3)** Re-alignment of malposed abutment. When the preparation of full metal and full veneer will cause exposure of the pulp.

**The retention of the post crown depends on:**

**1)** Taper of the root canal.  parallel sided prep. Is more retentive than tapered (diverage occluasly)

**2)** Post length.

Longer length more retention (2/3 length of root, Equal to length of clinical crown, 4-5 mm from apex, 8 mm deep from CEJ)

**3)** Post diameter.  one third the root diameter at C.E.J. and should be at least 2mm less than root diameter at mid root area)

**4)** Post surface texture.

For multi-rooted posterior teeth, the post should be placed in the largest canal.

For the maxillary molar use the palatal canal and for the mandibular molar use the distal canal.

For the maxillary premolar, the post should be placed in the buccal canal.

**Factors affect the selection of a tooth for post crown retainer:**

1- The root of the abutment should be of sufficient length, width and without sharp angulations in the middle third.
2- The root should be without internal or external resorption.
3- Quality of the root-filling: the canal should be filled with well-condensed gutta-percha especially in the apical 3rd of the canal.

## Resin bonded retainers

- Require minimal tooth preparation.
- Acid etched.
- Esthetically appealing.
- Economical, conservative, functional & do not irritate soft or hard tissues

**Indications:**

**1)** As retainers of FPD for abutment with sufficient enamel to etch.

**2)** Splinting of periodontally compromised teeth.

**3)** Stabilizing dentition after orthodontic treatment.

**Contraindications:**

**1)** In patients with sensitivity to base metal alloys.

**2)** When facial esthetic of abutment require improvement.

**3)** Inadequate enamel surface to bond eg;caries,existing restoration,attrition.

**4)** Incisor with extremely thin facio-lingual dimension.

## Pinledge

A partial veneer retainer preparation incorporating pins holes to provide retention.

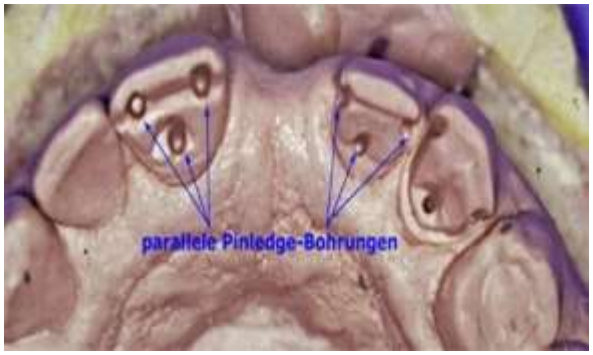
**Indications:**

**1)** High esthetic requirement.

**2)** Undamaged anterior teeth.

**3)** When proximal grooves are impossible to prepare.

**4)** To alter lingual contour of maxillary anterior teeth



**INLAY**

A fixed intra-coronal restoration; a dental restoration made outside of a tooth to correspond to the form of the prepared cavity, which is then luted into the tooth. Inlay may be used as

- single tooth restorations for proximo-occlusal or gingival lesions with minimal to moderate extensions.
- Minor retainer for fixed partial denture

They may be made up of gold alloy or ceramic material.

**Contraindications:**

**1)** high caries index.

**2)** Poor plaque control.

**3)** MODs.

**4)** Poor dentinal support requires wide preparation.

**ONLAY**

A restoration that restores one or more cusps and adjoining occlusal surfaces or the entire occlusal surface and is retained by mechanical or adhesive mean. It is used for restoring more extensively damaged posterior teeth needing wide mesio-occluso-distal restorations. It can be used as a retainer for fixed partial denture

**Contraindications**:

**1)** High caries risk.

**2)** poor plaque control.

**3)** Short clinical crown/extruded tooth.

**4)** Bruxism.

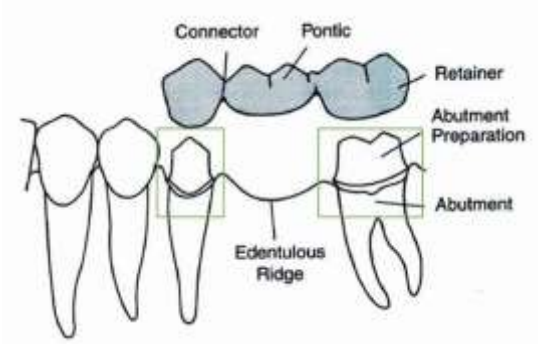

CL III INLAY
MINOR RETAINER
INLAY
ONLAY

# Crown & Bridge

**Lecture 7** **Dr. Farid**

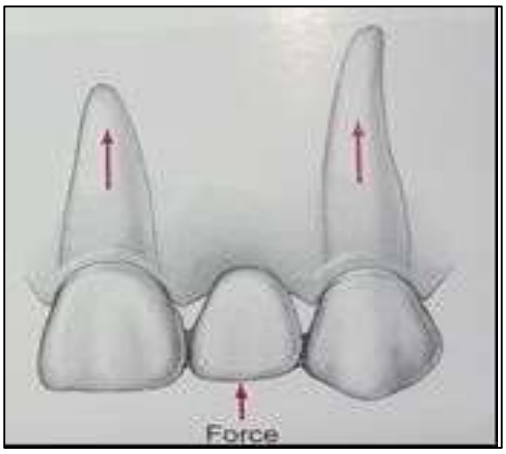
## Evaluation Abutment tooth

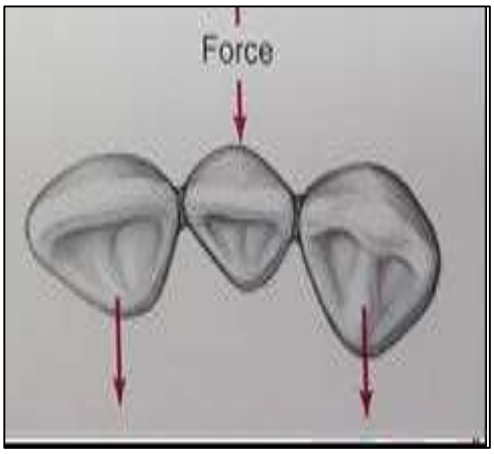
**Abutment in fixed prosthodontic terminology is** a tooth or portion of a tooth that supports and/or retains a fixed bridge or part of the bridge, to which the retainer is connected (cemented).





All forces that are absorbed by the missing tooth are transmitted, through the pontic, connectors, & retainers to the abutment teeth. Abutment teeth must withstand forces that are normally directed to the missing teeth, in addition to those usually applied to the abutments, therefore, the choice of abutment is important because it has to withstand the forces that acting on it and on the pontic.



**So the clinician has to evaluate the abutment teeth carefully**

Considerable time & expense are spared by thoroughly investigating each abutment tooth before proceeding the preparation. Radiographs are made & the pulpal health is assessed by evaluating the response to thermal & electrical stimulation.

**Evaluation Aids:**

They include; clinical examination using examination tools, vitality test, radiographs, diagnostic casts, & periodontal probe.

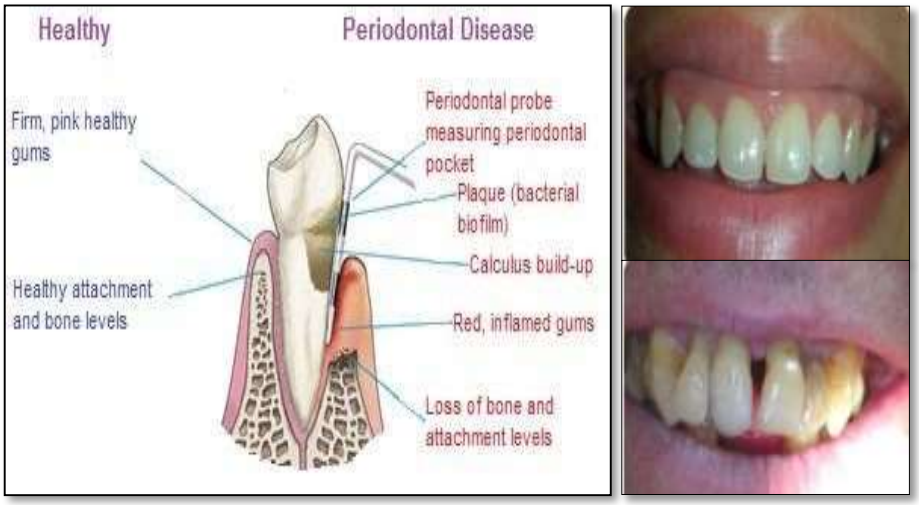
**Requirements:**

**1.** The abutment must withstand forces normally directed to the missing teeth, whenever possible the abutment should be vital tooth.

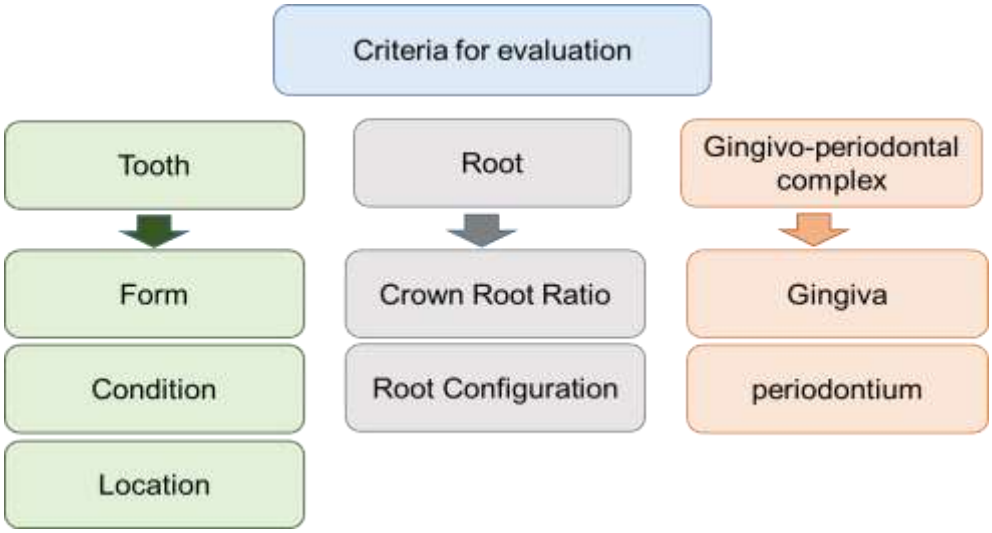
**2.** A symptomatic endodontically treated teeth with a radiographic evidence of good seal & complete obturation of the canal can serve as abutment (post & core for retention & strength).

**3.** The supporting tissue surrounding the abutment teeth must be healthy & free of inflammation.

**4.** Abutment teeth must not exhibit any mobility, since they will be carrying an extra load. Sever uncorrectable periodontal disease is contraindicated for FPD



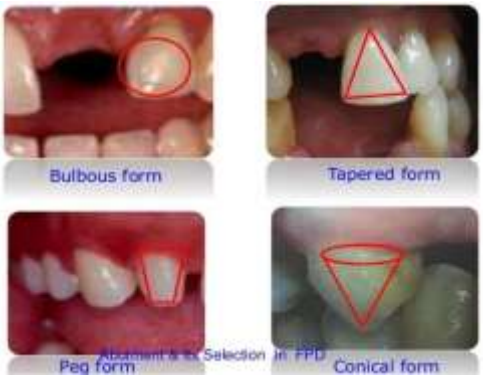
# Abutment evaluation (selection):




## Factors related to abutment tooth

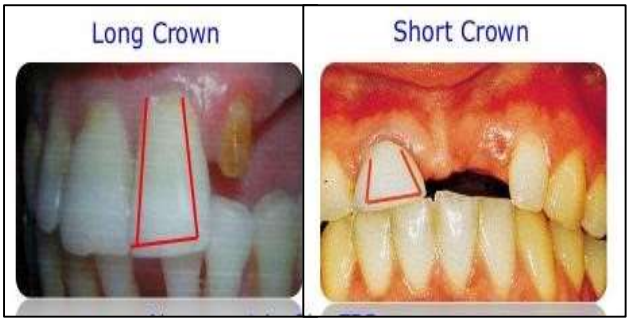
### 1. Shape:

Some teeth have conical, peg, bulbous or tapered crown form that interfere with the preparation parallelism, necessitating full coverage crowns to improve aesthetics and retention. Examples; Peg laterals, anterior teeth with poorly developed cingula and short proximal walls, mandibular premolars with poorly developed lingual cusps & short proximal surface, and thin incisors.

## 2. Crown length

Abutment teeth must have adequate occlusocervical crown length to achieve sufficient retention. Full coverage restorations & crown lengthening is considered with short clinical crowns to ensure adequate retention.



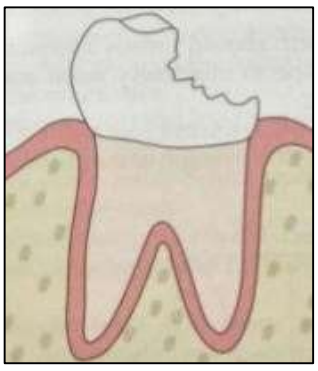


## 3. Size of the crown:

It determines the type of retainer to be used. For example: short, thin, conical, tapered teeth are poor indication for partial veneer crown.

## 4. Health of abutment (caries or pulpal):

- A sound abutment tooth permits ideal type of preparation. Carious tooth may be used as abutment if the caries is removed with pulp protection (lining) and then restored to its original form by suitable filling material.
- Degree of mutilation of the crown: The size, number & location of the carious lesion or restorations in a tooth will influence the type of the retainer on the abutment. If the caries is small and far away from the margin, the retainer design will extend beyond the caries area. If the mutilation/fracture is severe, removal of the tooth might be indicated.



- Vital teeth are preferred, however, pulpless teeth can be used only after endodontic treatment. Pulp capped teeth should be avoided because they are under risk of requiring RCT.
- Modifications like dowel core and pin retained restorations may be needed to restore crown morphology in grossly destructed teeth.

**5. Axial relationship:**

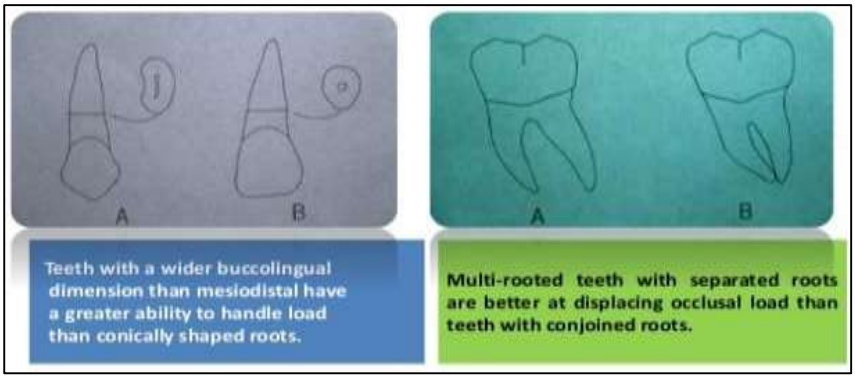
- Rotation, tilting, over lapping, malposition might lead to a decision of excluding such a tooth to be used as abutment (because rotation or torque can damage the supporting structure or cause retainer to become loose).
- It may indicate the use of specific retainer (over reduction lead to weaken the tooth & endanger pulp health).
- Rotation lead to either increase or decrease of space available for pontic (size of pontic planned).

## Factors related to root:

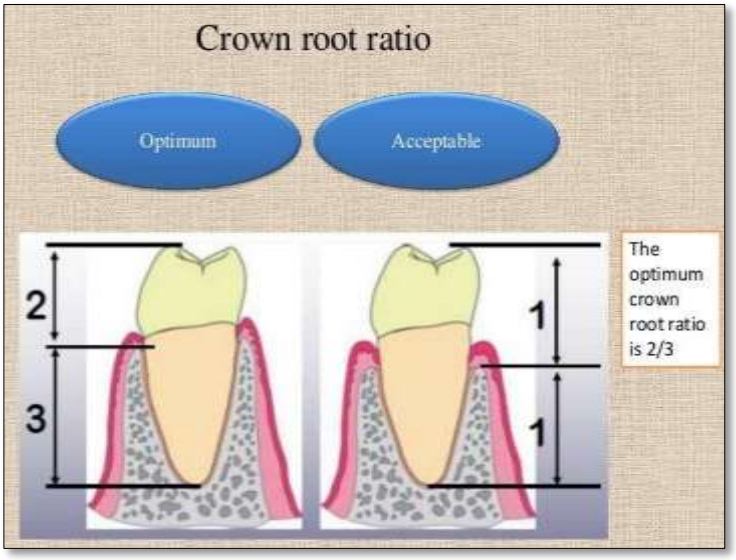
**1.** Root configuration (root shape, angulation & length)

- The shape of the roots determines the ability of the roots to handle the occlusal forces. Root that is wider labiolingually than mesiodistally with elliptic cross section offers better support than a tooth with similar root surface area but has a circular cross-section.
- Parallel-sided roots with developmental depressions are better to resist occlusal forces than smooth-sided conical roots which can be used for short span bridge, if the other factors are optimal.

- A single-rooted tooth with irregular configuration or with some curvature at the apical third of the root is preferable than tooth that has a nearly perfect taper.
- Multi-rooted teeth with separated roots provide greater stability than single rooted teeth or teeth with conjoined roots.
- Teeth with longer root are stronger abutment than shorter one, since root length is directly proportional to the stability & strength of the prosthesis.




**2.** Crown - root ratio: It is a linear measurement of the length of the tooth occlusal to the crest of alveolar bone (crown) compared to the length of the tooth that is embedded in the bone (root).



- 2:3 Crown/Root ratio is the optimum for a tooth to be used as abutment.
- 1:1 Crown/Root ratio is the minimum acceptable ratio. It might be considered adequate if the opposing occlusion is mobile or periodontally involved, or it composed of artificial teeth, which reduce occlusal forces that acting on the abutment which means less stress on the abutments.

**Factors related to Gingivo-Periodontal complex**

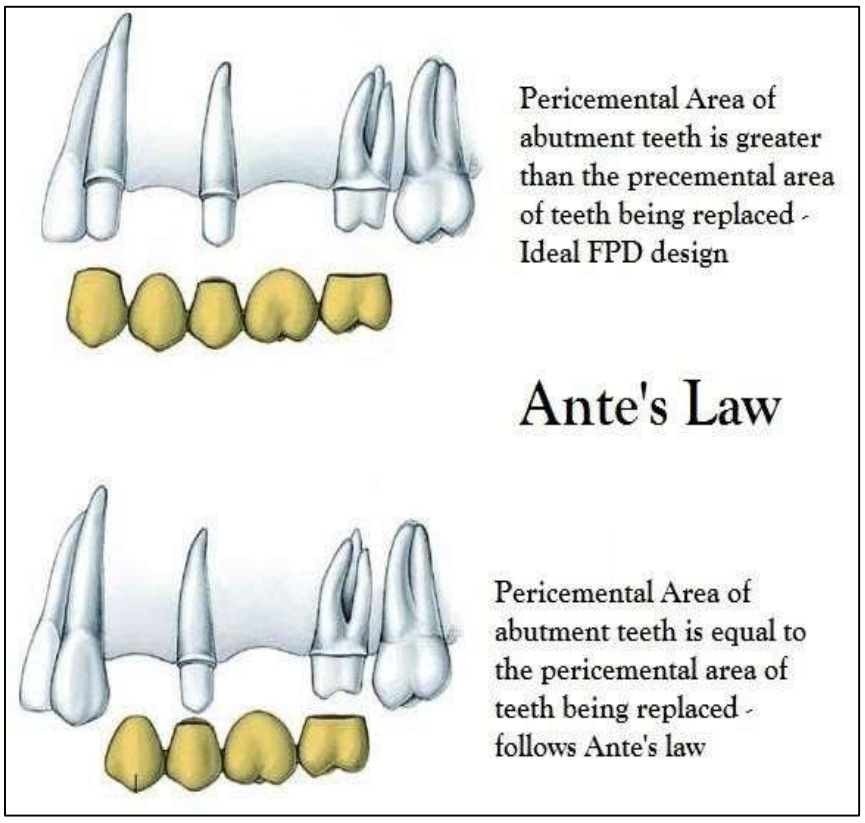
- Abutment teeth must be free from periodontal disease, periodontal pockets, osseous defect, and gingival inflammation with adequate zone of attached gingiva.
- The supporting tissue surrounding the abutment teeth must be healthy & free of inflammation. The abutment teeth should not exhibit any mobility, since they will be carrying an extra load. Intra oral radiograph should be used to evaluate bone architecture.
- The alveolar bone support is one of most important factors that aid to evaluate an abutment which must be healthy, have good trabecular architecture with no sign of bone defect or bone loss.

**3. Root surface area (Periodontal ligament area):**

- The periodontal ligament area can be used as a scale or measurement to determine the potency of an abutment for FPDs.
- Tylman stated that "Two abutment teeth could support two pontics".
- Johnston et al improvised Tylman's statement and proposed the famous ANTE's Law.

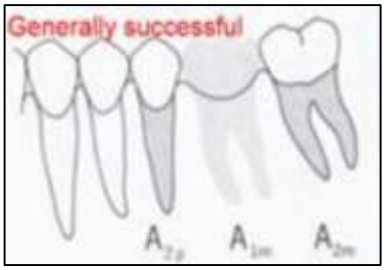
## Periodontal surface area “Ante's law”:

- The root surface area of abutment teeth (embedded in bone) (pericemental area) must be equal or greater than root surface area of teeth to be replaced.
- If the periodontal surface area seems inadequate, the use of multiple teeth for abutments may be indicated depending on other biomechanical factors.




**Example:** Missing 1st molar alone or with 2nd premolar, the root surface areas of both are equal to the root surface area of abutments (second molar & first premolar).

**According to this premise:** One missing tooth can be successfully replaced if abutment teeth are healthy. In selected case and in order to increase the capability of the bridge to withstand the loading force 1st premolar can be used as a secondary abutment.



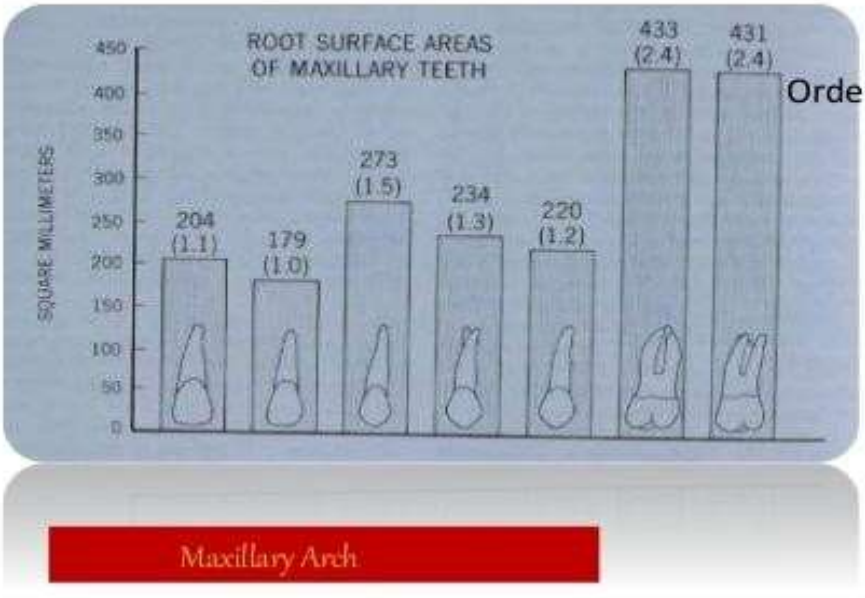

- If two teeth are missing, a FPD can probably replace the missing teeth but the limit is being approached.


- If three missing posterior teeth (1st molar & two premolars) or when the root surface area of the teeth to be replaced by pontics are greater than that of the abutment teeth, then a high risk or an unacceptable situation for FPD is exists.


- Jespen (1963) reported average measurements of root surface areas that can be used to calculate the abutment to pontic ratio

Abutment Evaluation

- Periodontal Surface Area (Ante's Law)




Order of Abutments concerning Periodontal Surface Area:

- First Molar
- Second Molar
- Canine
- First Premolar
- Second Premolar
- Central Incisor
- Lateral Incisor

# Crown & Bridge

**Lecture: 8** **Dr. Farid**

## Components of Fixed Partial Denture

## Pontic

It is the suspended portion of the fixed partial denture (bridge) replacing the lost natural tooth or teeth, restoring its function, and usually occupying the space of missing natural tooth.

**Components of the pontic (PFM):**

1- Metal backing. 2- Solder joint 3- Facing.


**Materials used in pontic fabrication**

The pontic may be made entirely of cast metal or porcelain or Zirconium. A combination of metal backing and porcelain or acrylic facing can be used also.

**Functions of the pontic**

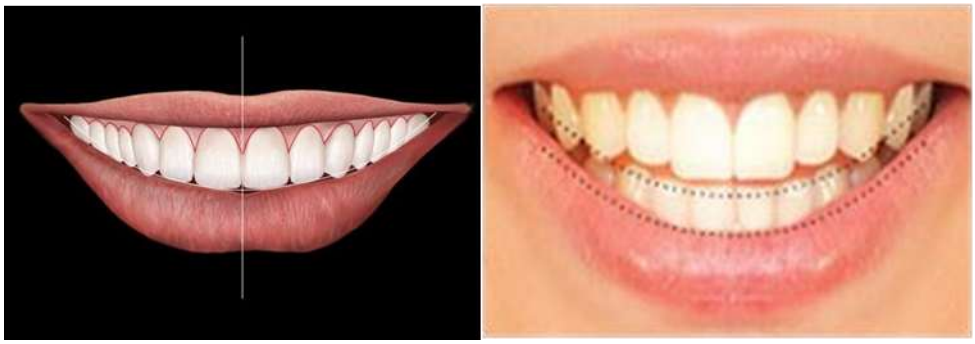
1) Mastication.
2) Speech (phonetics).
3) Esthetics (appearance).
4) Maintenance of tooth relationship.

**Ideal Pontic Requirements**

**Esthetic requirements**

**1.** The pontic should meet the demand of esthetic and comfort the deciding factor for esthetic value is smile line (The smile line is an imaginary line running from the incisal edges of the maxillary incisors and coinciding with the curvature of the lower lip). it locates the appearance zone of the facial aspect of the teeth, this quite true for the upper teeth, however for the lower teeth, most of the time only the higher portion of the facial aspect as well as the occlusal surface lie in the appearance zone. So to fulfill esthetic requirement pontic must;

- Looks like the tooth it replaces
- Tissue contacts appear as normal tooth.
- Lower lip line helps to evaluate buccolingual position of the incisal edge and the curvature of the incisal plan



In excessive bone loss it is possible to construct pontic with a length coincide with clinical requirement for that patient but for esthetic reason you can add pink porcelain to the apical portion of pontic to simulate gingival tissue.

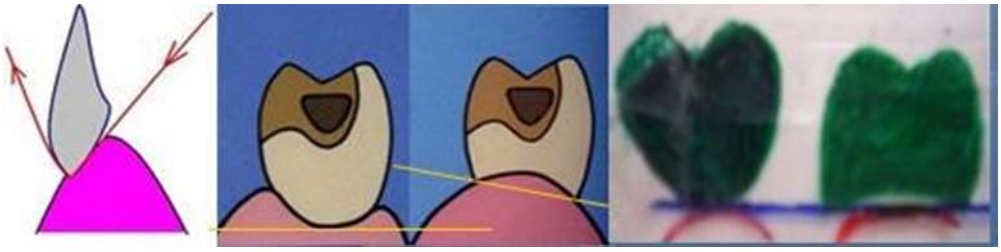
- Root can be stained to simulate exposed dentine.
- Pink porcelain to simulate the gingival tissues

**Biologic Requirements**

**2.** The pontic must be hygienic; permit maintenance of high standard of oral hygiene by the patient through providing good access for cleaning pontic underlying soft tissue, furthermore, pontic should prevent soft and hard tissue irritation. Pontic design should allow the patient to use devices such as brushes, super floss and dental floss without difficulties.

**3.** The tissue surface of the pontic should design so that it should not cause any problem to the underlying soft tissue (ulceration and inflammation) by pressure, a pressure free contact is indicating (passive contact, thickness of a film of saliva is sufficient when esthetic demand pontic facial surface to be lies within appearance zone)

**4.** The tissue surface of the pontic should design so that it should not cause any problem (irritation follow by inflammation) to the pontic underlying soft tissue by improper food staff shading, that is important for plaque formation, through poor pontic design or poor material selection (pontic tissue surface should be convex, ceramic)



 Glazed porcelain and highly polished metal (gold) are the preferred materials for tissue contact The glazed porcelain is the preferable material that should be used on those portion of pontic which approximate the edentulous ridge. Because their porous nature and difficulty in obtaining a highly polished surface, resins should not be used as near the soft tissue.

**5.** The contact area or solder joint should guard the interproximal area and the embrasure (mesial, distal and lingual) should be opened wide to allow massage of the gingival tissue.

**6.** The contour of the labial and lingual surfaces of the pontic must be proper and lie with the same line of contour of the adjacent teeth so it will allow stimulation as well as protection of the underlying tissue

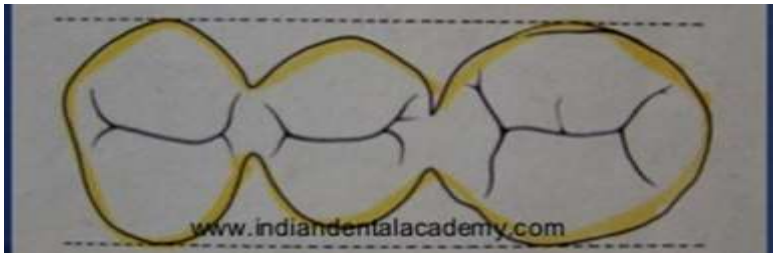
**Mechanical Requirements;**

**7.** The pontic must be strong enough to withstand the force to which it is subjected without deformation (Rigid & resistant to deformation). Part of pontic that subject to force usually made of metal or supported by it. All metal pontic may be needed in situation of high stress rather than metal ceramic pontic which is more susceptible to fracture. Mechanical problems may be due to

- Improper choice of material.
- Poor framework design.
- Week connectors
- Poor occlusion
- Poor tooth preparation

**8.** It should restore the function of teeth it replaced i.e. masticatory function efficiency must restore to the proper limit.

**9.** Sometime it is desirable to reduce the occlusal surface width by 20% to reduce torque on retainers and abutments and simplify the cleaning with minimal soft tissue contact, however, width of the pontic required will be governed by esthetic, span length, abutment teeth strength, ridge form and occlusion



## Summary of pontic Requirements:

- **Esthetic**

1. Looks like the tooth it replaces.
2. Tissue contacts appear as normal tooth.

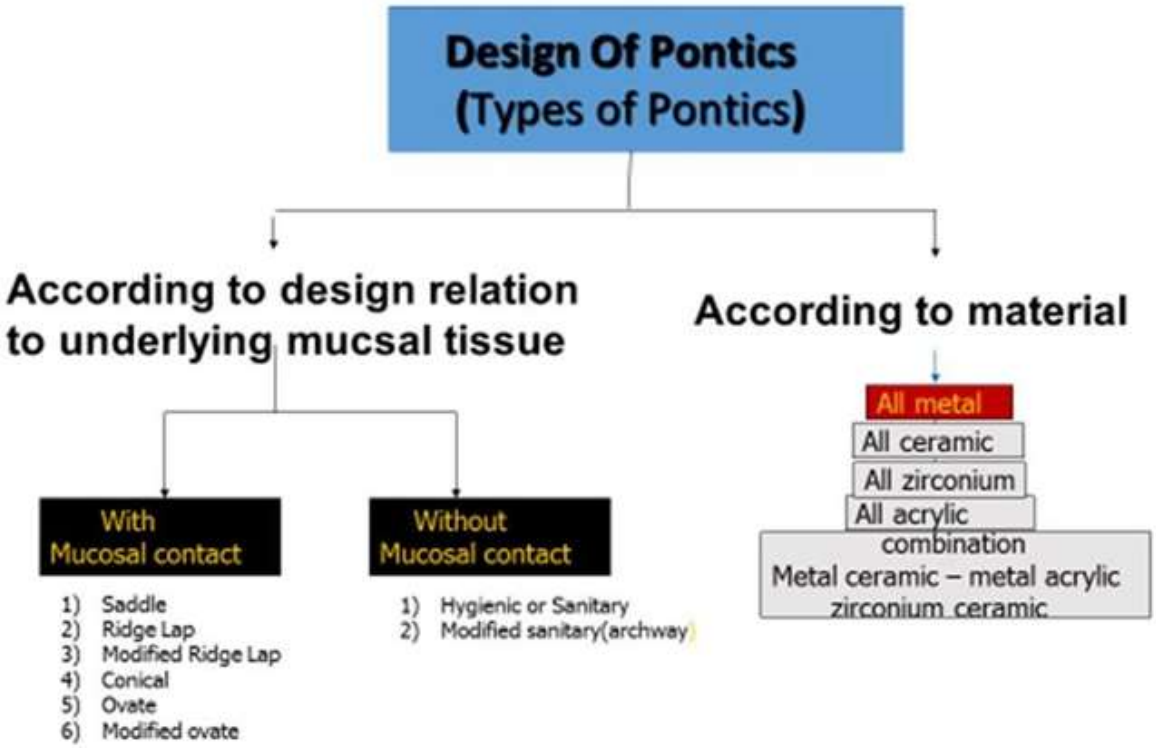
- **Biologic**

1. Can maintain healthy tissues.
2. Cleansable.

- **Mechanical**

1. Strong enough to withstand functional forces.
2. Rigid & resistant to deformation.
3. Provides normal function.

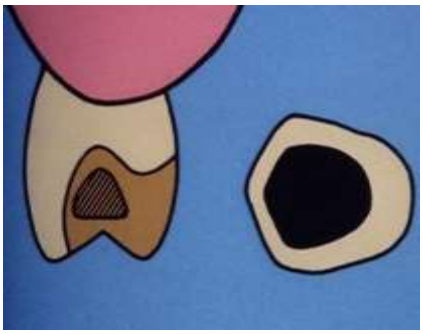
## Designs (Types) of Pontic:



(A) Pontics with mucosal contact:

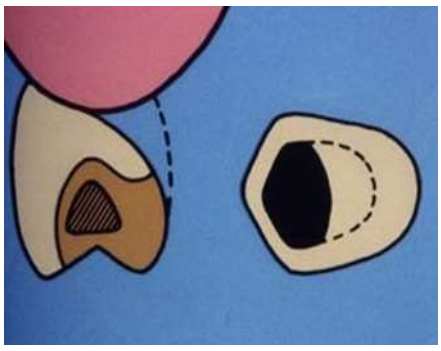
**1.** Saddle Pontic (full ridge lap)

- Overlaps the ridge (largest area of contact)
- Most natural feeling
- Most difficult to clean (concave tissue surface overlying residual ridge BL)
- Should never be used
- Used for o Limited occlusal-gingival space o Patients who object to lingual space



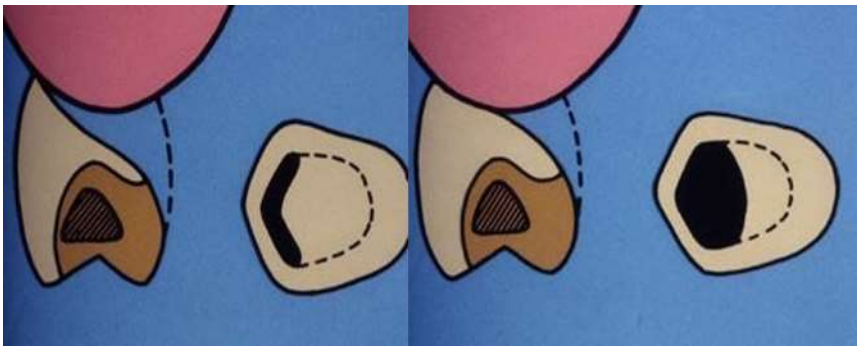
**2.** Ridge Lap Pontic

- Like saddle on buccal
- Convex on the lingual
- More cleansable than saddle design
- Potential for tissue irritation minimized
- Give the illusion of being tooth
- Combines best features of saddle & hygienic pontics
- Used when the tooth lies in the appearance zone (max & man.)



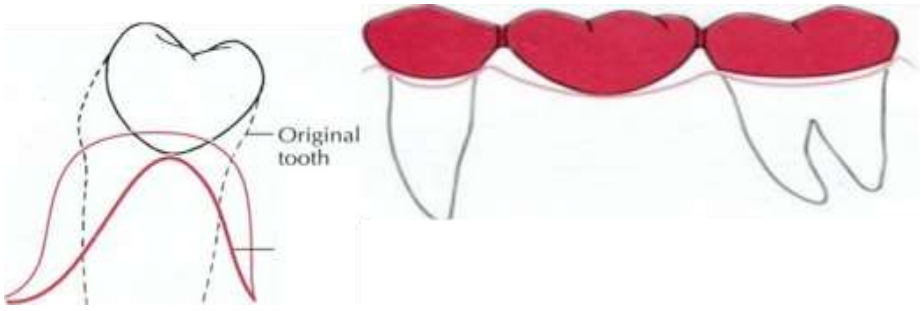
**3.** Modified Ridge Lap Pontic

- Contacts tissue only on most facial surface of the pontic
- Most cleansable
- Least tissue irritation
- Space between pontic and tissue on lingual can be unacceptable to the patient
- Used when the tooth lies in the appearance zone (max & man.)



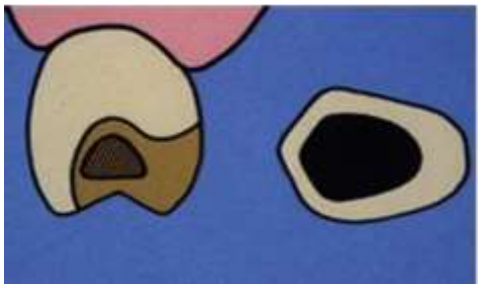
**4.** Conical Pontic (bullet, spheroid)

- egg shaped or spheroid shape.
- used as pontic in non-esthetic areas.
- convex shape with only one point touches the residual ridge.
- The easiest design to clean.
- Used when occlusal 2/3 of the facial surface lie in the appearance zone but not gingival 1/3 (lower incisors, premolars and molars).
- if used with broad, flat ridge, this lead to debris trapping embrasure space.



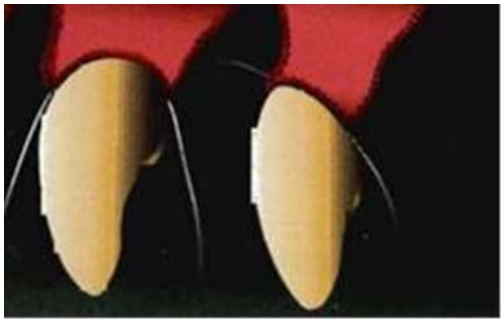
**5.** Ovate Pontic

- Placed in convexity on edentulous ridge
- Appears to be growing out of tissue
- Natural feeling for patient
- Difficulty in cleaning
- Potential for tissue irritation
- Used for Maxillary incisor and premolars
- Requires surgical preparation



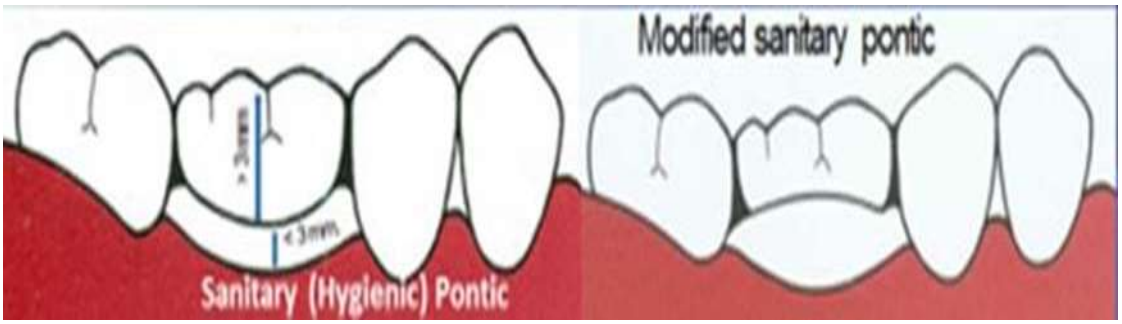
**6.** Modified Ovate Pontic

- The modification of the ovate pontic involves moving the height of contour at the tissue surface from the center of the base to a more labial position.1_1.5mm apical and palatal to gingival margin
- The modified ovate pontic does not require as much faciolingual thickness to create an emergence profile.
- Excellent esthetics
- Fulfilled functional requirements
- Greater ease of cleaning compared with the ovate pontic owing to the less convex design.
- Its major advantage over the ovate type is that often there is little or no need for surgical augmentation of the ridge



**7.** Hygienic Pontic (sanitary, wash through);

- Made entirely from metal
- Doesn’t have any contact with underlying tissue
- Primary design for the non-appearance zone in mandibular posterior regions
- Most cleansable
- Convex shaped
- No tissue contact
- 3 mm space
- 3 mm thickness
- Patient acceptance? Questionable 8. Modified Hygienic Pontic (Archway pontic)
- A modified version of the sanitary pontic.
- It gingival portion is shaped like archway between the retainers
- This geometry added bulk for strength in the connectors while decreasing the stress concentrated in the pontic and connectors
- Made entirely from metal
- Doesn't have any contact with underlying tissue
- Primary design for the non-appearance zone in mandibular posterior regions
- Access for cleaning is good, also, tissue Susceptible to proliferation that can occur when the pontic is too close to the residual ridge  No tissue contact
- Patient acceptance? Questionable.



## Components of Fixed Partial Denture (Bridge)

## Connector

It is that part bridge or F.P.D which joins the individual components (retainers or pontics) together, retainer with pontic, retainer with retainer or pontic to pontic. This can be accomplished by non-rigid movable (flexible) connector or, most commonly, rigid (fixed) connector.

### Types of Connectors

1. Rigid
- All metal
- Metal-ceramic
- All ceramic

2. Non Rigid
- Prefabricated in plastic or metal and incorporated into the wax pattern
- Milled into the wax pattern or casting

PRINCIPLES CONNECTORS DESIGN

1-size

Connectors must be sufficiently large to prevent distortion or fracture during function, but, not too large to prevent interference with plaque, periodontal tissue disturbance over time.

2-shape

The shape of the tissue surface of the connector should be curved faciolingually and highly polished and smooth to facilitate cleaning and patient should be satisfied with the appearance.

3-postion

The location of the contact area should be established correctly to influence the success and stability of the prosthesis. In the anterior teeth, the connector should place lingually. In the posterior teeth, located in the occlusal third of the crown and more lingually

# CROWN AND BRIDGE

**Lecture: 9** **Dr Farid**

## *Try-in & Cementation*

The crown should be checked for fitness and adjustment for the occlusal surface with the opposing teeth and also the contact area should be checked and adjusted.

▶ Remove the provisional restoration and clean the tooth. Then insert the bridge frame and check the followings:

1. **The proximal contact area**: - The proper contact should have a slight resistance to the passage of dental floss. We should have neither too tight (heavy) contact nor too light (loose) contact.

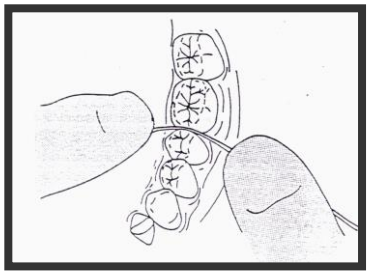
**Too heavy contact results in: -**

- ✓ Interfere with correct seating of the restoration.
- ✓ Produce discomfort, and make it difficult for the patient to floss.
- ✓ Too much force will be exerted on the adjacent tooth.

**Too light contact results in: -**

- ✓ Food impaction, which is deleterious to the gingival and annoying to the patient.
- ✓ Drifting of the adjacent teeth, which affect the occlusion of the patient.

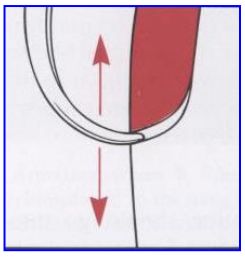
2. **The margins of the retainer (s).**



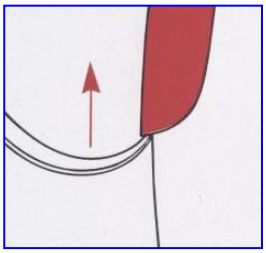
The margin is the most critical area of the restoration; we should have complete fitness between the restoration margin and finishing line of the preparation.

**The defective margin of the restoration might be**:

- Short margin (under extension), margin is short of finish line. In this case we should check: -



- ✓ If there too tight proximal contact that prevent complete seating.
- ✓ The internal surface of the retainer if it locked into parallel or slight undercut in the tooth surface that prevent complete seating, may be checked by indicator spray that applied to (coat) the internal surface of the retainer, then seat the retainer, remove the retainer and see if there is premature contact spot which is devoid the spray material.
- Long margin (over extending margin), margin beyond finish line. We should cut the excess.



- Open margin: the margin within the finish line but there is space between the restoration margin and prepared tooth. If we can burnish it. Otherwise repeat the impression.

  Burnishing depends on the type of metal and the type of finish line.

  The burnishable metal usually is gold. The knife edge (feather) and shoulder with bevel finish line could be burnished.

  The objective of the margin finishing (burnishing) is to obtain at least one mm wide margin of metal that is closely adapted to the tooth surface at the area of finish line so that any dissolution of luting (cementing agent) is minimized.

  **Two types of margin need to be considered during finishing procedure**:

1- Subgingival margin that can be burnished on the die using a burnisher,

   No intra oral finishing is desirable for the subgingival margin because the risk of damaging to the tooth and periodontal structure.

2- Supra gingival margin that can be finished directly on the tooth inside the patient mouth. Margin finishing or adaptation can be improved by using burnisher or round bur.

### 3. Occlusal Adjustment

It is done by using articulating paper in centric and eccentric relation. Remove the premature contact with stone bur and always check the metal thickness with metal gauge to avoid over thinning of the metal that could affect structural durability. The

occlusal relationship of the adjacent teeth with the opposing is used as a guide for any prematurity.

4. **Shade Selection**. It depends on the followings:

A. Observer (dentist). B. Object (patient). C. Light source.

Each of these three factors is a variable and, when any one is altered, the perception of color changes.

Some guidelines for shade selection: -

Use the shade guide that matches the porcelain your technician is using.

The shade should always be matched prior to preparation of the tooth to be restored.

Ask the patient to remove all distractions before attempting to match a shade. Lipstick in particular should be removed and large bright items, such as earrings or glasses.

Be sure that the teeth are clean and unstained before shade selection.

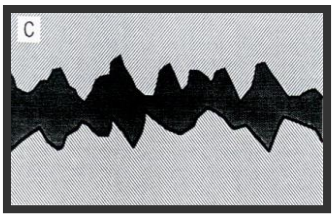
Seat the patient in an upright position with the mouth at the operator's eye level.

Position yourself between the patient and the light source. Observations should be made quickly (5 seconds or less) to avoid fatiguing the retina.

Try to take the shade under natural day light, avoid incandescent and fluorescent lights.

# Cementation

Dental cement doesn't contribute to the retention of the restoration. It is used only to fill the micro-spaces or small irregularities between the tooth structure and the restoration when it sets. It provides a mechanical bond (interlocking) that prevents the restoration from removal.




The mechanisms that hold a restoration on a prepared tooth can be divided into: -

- **Non-adhesive (mechanical) luting.**

The non-adhesive luting agent holds the restoration in place by engaging small irregularities on the surfaces of both tooth and restoration. Zinc phosphate cement is an example.

The nearly parallel opposing walls of a correctly prepared tooth make it impossible to remove the restoration without crushing minute projections of cement extending into recesses in the surface

- **Micromechanical bonding.**

The deep micro-spaces or irregularities on the tooth surface produced by acid etching and on the metals by electrolyte etching or chemical etching. Resin cement is an example. It can provide effective micromechanical bonding. The tensile strength of such bonds can sometimes exceed the cohesive strength of enamel.

- **Molecular adhesion.**

Involves physical forces like van der waals and chemical bonds (ionic, covalent) between the molecules of tow different substances. Poly-carboxylates and Glass ionomers are examples.

**Function of Cement**:

1- To secure a lasting retention of the restoration to the prepared tooth.
2- To seal the gap against penetration of fluid and bacteria from oral cavity.
3- To act as an insulating barrier against the thermal and galvanic activity.

**Properties of Ideal Luting Agent:**

1. Should have good working and setting property.
2. Adequate strength.
3. Compressible into a thin layer.
4. Should provide good sealing. And must be non-toxic to the pulp.
5. Should adhere well to the inner surface of the restoration.
6. Low viscosity and solubility.

In fact, we have different types of cement that are used as luting agents:

**Zinc Phosphate Cement**

It is the traditional luting agent that have proven itself after years of work, it has compressive strength of 14000-16000 PSI, with low PH at the time of cementing (about 3.5) which might irritate the pulp.

**Zinc Silico-phosphate Cement**

Has compressive strength of 22000 PSI but it has highly acidic PH and affect the health of the pulp (irritant).

**Poly-Carboxylate Cement**

Adhere to enamel, dentine and stainless steel but not to gold alloy.

The setting PH is (4.8) but because of the large size of poly-acrylic acid molecule, it has less effect on the pulp, high bond strength to enamel (1300 PSI) but its binding to dentine is considerably less 480 PSI.

**Glass Ionomer Cement**

Has compressive strength of 18600 PSI and it bonds to enamel and dentine (to enamel more), it releases fluoride after setting which is indication of an ability to inhibit secondary caries.

**Composite Resin Cements**

Resin cements are composites composed of a resin matrix, and a filler of fine inorganic particles. They differ from restorative composites primarily in their lower filler content and lower viscosity. Resin cements are virtually insoluble and are much stronger than conventional cements.

Excessive film thickness and setting shrinkage are the short comes of resin cements.

**Plain Zn-oxide** is not used for permanent cementation because:

1- It has poor oral durability due to continuous eugenol loss.

2- Also it possesses low compressive strength, so we use it for temporary cementation.

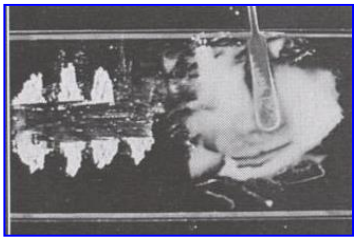
The selection of cement for placement of cast restoration is not clear cut discussion.

**Cementation Procedure for Zinc phosphate cement:**

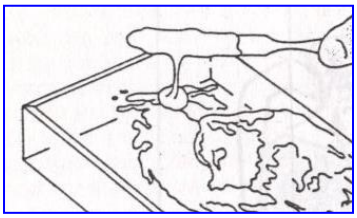
We prepare the tooth inside patient mouth, before start mixing the cement:

1. Remove the temporary crown, cleaning of restoration from any residues of cement, etc:

   Then dry the area of the prep. And with cotton roll isolate the area of work from any salivary contamination to assure complete dryness during cementation procedure.
2. We apply two layers of varnish on the preparation except the margin.
3. Then start mixing cement.

   ZnPC is mixed on a cool cement slab, the cement is divided into increments and it should be done over a wide area of the cement slab, mixing is done with a circular motion to dissipate heat, when the cement reach a creamy mix it should string out of the cement spatula, at this stage the cement is ready for working with.

   
4. Apply a coating of the cement to the inside of clean dry casting restoration, if there is any internal prep. Features such as grooves or boxes apply some cement on these areas of prep.
5. Seat the casting crown on the tooth with pressure and ask the patient to apply force to the occlusal surface of the casting by biting on wooden stick or cotton roll for 3-4 minutes to ensure complete seating.
6. After setting remove any excess cement from the inter-proximal area, and clean it with air water spray.

   Note: don't try to cement poorly fit causing crown restoration because the cement will dissolve in oral fluid so caries will develop under the restoration and it will be lost in future.

Reference: Contemporary Fixed Prosthodontics

# CROWN AND BRIDGE

**Lecture: 10** **Dr Farid**

## Ceramics and metal-bonded ceramics

The word ceramic is derived from the Greek word keramikos, which literally means 'burnt stuff' but which has come to mean more specifically a material produced by burning or firing.

## Composition of traditional dental porcelain:

The main ingredients are feldspar, silica, kaolin and pigments, only the purest ingredients are used in the manufacture of dental porcelain

The improved translucency of the modern dental ceramic materials was mainly achieved by the lowering of the kaolinites content or its complete removal from the composition.

### *1- Kaolin*

Kaolin is a hydrated alumino-silicate. Only the purest clay or kaolin is used in porcelain. Kaolin gives porcelain its properties of opaqueness, when mixed with water, it becomes sticky and aids in forming a workable mass at the porcelain during molding.

### 2- *Silica*

Pure quartz crystals ($SiO_2$) are used in dental porcelain, silica remains unchanged at the temperature normally used in firing porcelain, and this contributes stability to the mass during heating by providing a framework for other ingredients.

## *3- Feldspar*

Feldspar is the lowest fusing component and it is this which melts and flows during firing, uniting the other components in a solid mass.

Natural feldspars are mixtures of albite Na2AL3 $Si_6O_{16}$ and orthoclase K2AL7Si6O16 with free crystalline quartz. These feldspars are never pure and the ratio of soda ($Na_2O$) to potash ($K_2O$) may vary quite considerably, for dental purposes, high potash content feldspar is generally selected because of its increased resistance to pyro-plastic flow.

Feldspar contains oxides of both potassium and sodium; these break down the Si-O network and thus are known as glass modifiers.

***Two consequences result:***

1. The softening temperature of the glass is reduced.
2. The coefficient of thermal expansion is increased and extensive breakdown of the Si-O network may occur, and devitrification results from crystallization of the glass. This occurs if porcelain is fired too often, and it is typically associated with loss of physical properties and appearance

## *4- Pigments*

The coloring pigments added to the porcelain mixture are called “color frits”, they are prepared by grinding together metallic oxides with fine glass and feldspar, these frits are added in small quantities (less than 1%) to obtain the delicate shade necessary to imitate the natural teeth.

# Types of porcelain

*According to the firing temperature porcelain is classified as:

A. High – fusing: 1290 to 1370C (2350 to 2500F).

B. Medium – fusing: 1090 to 1260C (2000 to 2300F).

C. Low – fusing: 870 to 1065C (1600 to 1950F).

D. Ultra – low fusing < 850C (1562F).

High–fusing porcelains are considered superior in strength, solubility, translucency, and maintenance of accuracy in form during repeated firing. Low firing temperatures are a definite assist in the fusion of porcelain to metal, since the differences in the coefficients of expansion of the porcelain and metal can be tolerated better at lower temperature ranges. The low–fusing and ultra–low–fusing porcelains are used for crown and bridge construction, some of the ultra–low–fusing porcelains are used for titanium and titanium alloys because of their low – expansion coefficients that closely match those of the metals and because the low firing temperature reduces the risk for growth of the metal oxide. One problem regarding low–fusing porcelains lies in their surface and color stability.

low–fusing porcelain was developed to offset the major disadvantages of traditional dental porcelains representing a major change in direction, one of the basic differences between this formulation and those that have been used for long periods of time is a significant reduction in the firing temperature being as 760C for a newer type (finease) versus around 940C for conventional type. It permits the clinician to generate a highly polished surface at chair side, thereby eliminating the need for reglazing after possible adjustments.

Another advantage regarding low–fusing porcelain reported was the less potential for abrading any materials against which it occludes.

# Properties of porcelain

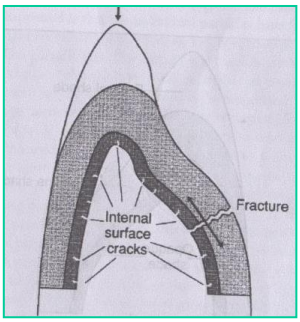
- ✓ Dental porcelain provides excellent aesthetics that do not deteriorate with time. Unfortunately, its brittleness, low tensile and shear strengths render the porcelain restoration liable to fracture during mastication. Brittle dental ceramics are incapable of absorbing appreciable amounts of elastic strain energy before fracture.

✓ It is available in a range of shades and at various levels or translucency such that a most life-like appearance can be achieved.

✓ Although the compressive strength of dental porcelain is high, its tensile strength is very low, which is typical of a brittle solid. Porcelain (glasses) is extremely sensitive to the presence of surface microcracks. The superficial cracks which result due to thermal stresses are best avoided by slow cooling from the firing temperature.

Fracture can be initiated from the followings: -

❖ Small surface scratches in the outer surface caused by grinding and these should be eliminated by smoothing or by further fusing.




❖ Cracks in porcelain crowns invariably initiate from the inner, unglazed fitting surface and propagate outwards towards the exposed surface material.

❖ The brittleness of dental ceramics is compounded by their tendency to undergo ' static fatigue'. This is time-dependent decrease in strength, even in the absence of any applied load. The process is thought to occur through alkaline hydrolysis of Si-O groups within the porcelain structure. Alkalinity within the material results from a solubilization of Na20 and K20 which forms part of the feldspathic component of porcelain. Dynamic mechanical loading further accelerates the weakening and the whole process has been likened to stress corrosion cracking, which can occur with metals and alloys. Attempts to overcome some of these problems involved reducing the proportions of Na20 and K20 within the materials.

✓ Porcelain is compatible with soft tissue and it possesses high wear resistance

✓ Porcelains are poor conductors and therefore are excellent insulators for the abutment teeth against thermal and electrical shock. This fact is of

importance when gross amounts of enamel and dentine are to be replaced and the residual layer of dentine may be of minimal thickness.

- ✓ Correctly formulated porcelain is very resistant to chemical attack, being unaffected by the wide variations of pH which may be encountered in the mouth.
- ✓ The relatively poor mechanical properties of porcelain can be improved using alumina, or metal supporting structures: -

### A. Alumina inserts and aluminous porcelain:

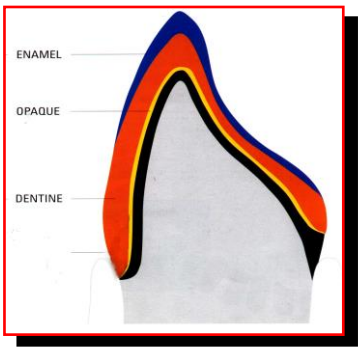
The major disadvantage of porcelain is brittleness and this is the factor, which most limits its use. Several methods are available which are aimed at preventing the formation or propagation of cracks on the inner surface of porcelain restorations.

- One approach is to use a core of pure alumina on which the porcelain crown is constructed. Alumina particles is a very hard (stronger than the glass), opaque material which is less susceptible to crack propagation (crack stoppers) than porcelain.
- Powdered alumina may be added to porcelain in order to achieve a significant strengthening. The mechanism of strengthening is that the alumina particles act as 'crack stoppers' preventing the propagation of a crack throughout the body of the porcelain.

### B. Metal bonded porcelain

It involves a marrying of the good mechanical properties of casting dental alloys with the excellent aesthetic properties of porcelain.

# Types of porcelain:




1- **Opaque porcelain**: It is applied as a first ceramic layer and performs two major functions: it masks the color of the alloy, and it is responsible for the metal ceramic bond.

2- **Body porcelain**: this is fired onto the opaque layer, usually in conjunction with the incisal porcelain. It provides some translucency and contains oxides that aid in shade matching. Body porcelains are available in a wide selection of shades, to match adjacent natural teeth.

3- **Incisal porcelain**: this is rather translucent; as a result, the perceived color of the restoration is significantly influenced by the color of the underlying body porcelain.

## The Alloy-Porcelain Bond Mechanism

A proper bond between the porcelain and the alloy is one that is stronger than the porcelain itself; therefore, the porcelain rather than the bond will fail cohesively.

An understanding of the bonding mechanisms is essential for successful metal–ceramic restoration.

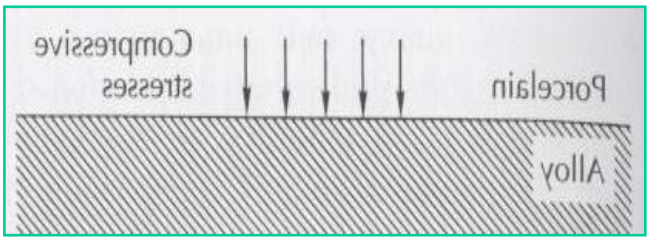
Mechanisms have been described to explain the bond between the ceramic veneer and the metal substructure: -

### A. Mechanical entrapment

By interlocking the ceramic with microabrasions in the surface of metal coping, takes place by penetration of the porcelain within the roughness of the casting surface which is produced by finishing the metal with non contaminating stone or disc and air abrasion.

## B. Compressive forces (Physical Bonding)

This bond is developed by a properly designed and a slightly higher coefficient of thermal expansion for the metal coping than for porcelain veneered over it. This will cause porcelain to “draw” toward the metal coping when the restoration cools after firing, so the porcelain will be firmly bounded to the metal .




## C. Chemical bonding

Metal and porcelain react chemically in an oxidizing atmosphere at approximately 1000$^{o}$C to bond together. It is indicated by the formation of an oxide layer on the metal.

It is the ability of the fused porcelain to absorb ions from the metal that produces a chemical bond between a metal and porcelain (migration of indium or tin to the alloy surface to form an oxide that combines with the porcelain during its firing). The alloy must contain at least one component that will be soluble in the fused porcelain without losing its contact with the basic chemical structure of the metal.

**Requirements of the alloys:**

**1-** The alloy, having been previously cast into the desired shape, should be capable of withstanding porcelain firing without melting or suffering creep. Hence the alloy must have a high fusion temperature.

**2-** The alloy should be sufficiently rigid to support a very brittle porcelain veneer otherwise a fracture of the veneer is inevitable.

**3-** The alloy should be capable of forming a bond with the porcelain veneer in order that the latter does not become detached.

**4-** The alloy should have a value of coefficient of thermal expansion similar to that for the porcelain to which it is bonded.

Reference: Contemporary Fixed Prosthodontics

# CROWN AND BRIDGE

**Lecture: 11** **Dr. Farid**

# ALL-CERAMIC RESTORATION

It is the most esthetically pleasant prosthodontic restorations. Because there is no metal to block light transmission, they can resemble natural tooth structure better in terms of color and translucency than any other restorative option.

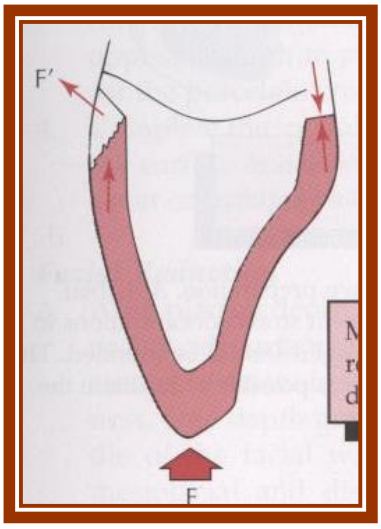
Their chief disadvantage is their susceptibility to fracture, although this is lessened by use of the resin – bonded technique.

Differ from other cemented crowns because it is not cast in gold or other metal. It is capable of producing the best cosmetic effect of all dental restorations. However, since it made entirely of ceramic, a brittle substance, it is more susceptible to fracture.

## Complete Ceramic Crowns: -

Preparation design of this type should give maximum support to the porcelain.

**Design features that give maximum support to the porcelain**.




- Preparations should be left as long as possible. An overshortened preparation will create stress concentrations in the labiogingival area of the crown, which can produce a characteristic 'half –moon' fracture in the labiogingival area of the restoration.
- A shoulder of uniform width 1 mm is used as gingival finish line to provide a flat seat to resist forces directed from the incisal. A 90-degree shoulder (cavosurface angle) is needed to prevent unfavorable distribution of stresses.
- The incisal edge is flat and placed at a slight inclination toward the linguogingival to meet forces on the incisal edge and prevent shearing.
- All sharp angles of the preparation-should be rounded to reduce the danger of fracture caused by points of stress concentration.

## Advantages: -

- Superior esthetics, excellent translucency.
- Good tissue response.
- Labially more conservative than metal – ceramic crown (lack of reinforcement by a metal substructure permits slightly more conservative reduction of the facial surface than is possible with the metal – ceramic crown, although the lingual surface needs additional reduction for strength).
- The appearance of the complete restoration can be influenced and modified by selecting different colors of luting agent.

## Disadvantages: -

1- Reduced strength due to absence of reinforcing metal substructure.

2- Because of the need for a shoulder type margin circumferentially, significant tooth reduction is necessary on the proximal and lingual aspects. Porcelain brittleness, when combined with the lack of a reinforcing substructure, requires a circumferential support with a shoulder. Thus, by comparison, the proximal and lingual reductions are less conservative than those needed for a metal- ceramic crown.

3- Remember the "Un forgiving" nature of porcelain if an inadequate tooth preparation goes uncorrected, can result in fracture

4- All –ceramic crowns are not effective as retainers for a fixed partial denture: although the strongest systems may be suitable for anterior application the brittle nature of porcelain requires that connectors of large, cross-sectional dimensions (minimum of 4x4mm) be incorporated in the FPD design typically this leads to impingement on the interdental papilla by the connector, with increased potential for periodontal failure.

## INDICATIONS:

1- High esthetic requirement.

2- Considerable proximal or facial caries, that no longer be effectively restored with composite resin.

3- Relatively intact incisal edge. Thickness of porcelain should not exceed 2mm; otherwise, brittle failure of the material will occur.

4- Favorable distribution of occlusal load. Centric contacts are best confined to the middle third of the lingual surface, leaving the crown out of contact is not recommended, future eruption may lead to protrusive interference, which results in fracture.

# CONTRAINDICATION:

1- When a more conservative restoration can be used.

In molar rarely we use all ceramic crowns because the increased occlusal load and the reduced esthetic demand make metal-ceramic crown the treatment of choice.

2- Teeth with short clinical crown don't have enough preparation length to support the lingual and incisal surface of the restoration.

3- Thin teeth faciolingually.

4- Bruxism.

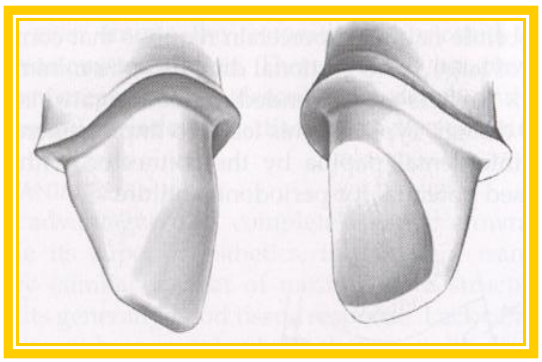
5- Should be avoided on teeth with an edge-to-edge occlusion that will produce stress in the incisal area of the restoration, also it should not be used when the opposing teeth occludes on the cervical fifth of the lingual surface tension will produced…half-moon fracture.

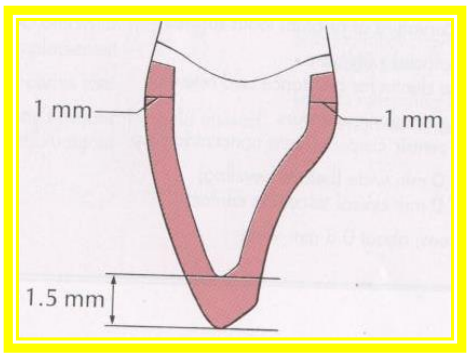
## PREPARATION:

The preparation sequence for a ceramic crown is similar to that to that for a metal-ceramic crown; the principle difference is the need for a 1-mm-wide shoulder circumferentially.

All-ceramic crown made over shoulder finish line exhibit greater strength than those made over chamfer.

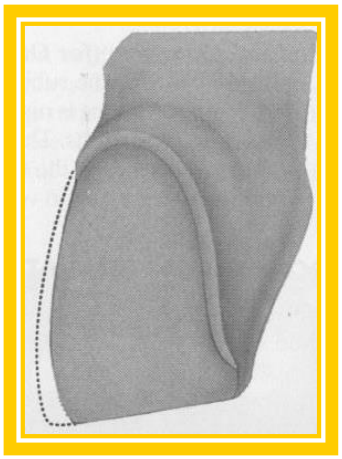
Care must be taken not to create undercuts in the axial walls where they join the shoulder.





# Porcelain laminates veneers

It consists of thin shell of porcelain applied directly to tooth structure; it is a conservative method of restoring the appearance of discolored, pitted, or fractured anterior teeth. It consists of bonding thin ceramic laminates onto the labial surfaces of affected teeth.



**Uses:**

1- Improve the color of stained teeth.

2- Alter contours of misshapen teeth.

3-Close inter proximal spaces.

**Advantages:**

1- Conservative of tooth structure.

2- Wear and stain resistance.

Esthetic veneers should always be considered as a conservative alternative to cemented crowns and have largely replaced M-C-crowns for the treatment of multiple discolored but otherwise sound teeth.

**Disadvantage**

1- Increase tooth contour.

2- The main disadvantage is the difficulty in obtaining restoration that is not excessively contoured.

# Preparation: -

Preparation is minimal and remaining within enamel,

## Step –by- step procedures:

The gingival third and proximal line angles are often over contoured with these restorations. Therefore, maximum reduction should be achieved with minimum penetration into the dentin.

1- Make a series of depth holes with a round bur, the required amount of reduction will depend on the extent of discoloration. A minimum of 0.5mm is usually adequate. The reduction should follow the anatomic contours of the tooth.

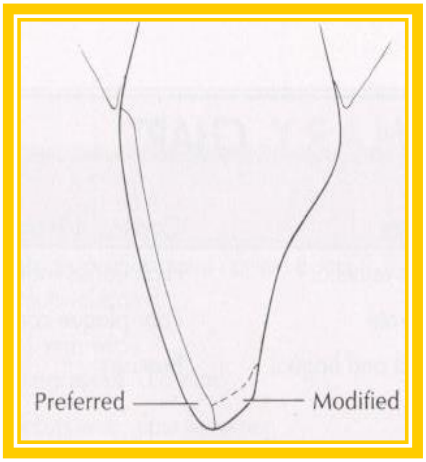
2- Place the (long chamfer) margin. This design has an obtuse cavo-surface angle which exposes the enamel prism ends at the margin for better etching.

3- Wherever possible, place the preparation margin labial to the proximal contact area to preserve it in enamel. Sometimes the proximal margins are extended lingually to include existing restoration.

4- If possible, do not reduce the incisal edge, this helps support the porcelain and makes chipping less likely.

- If the incisal edge length is to be increased, the preparation should extend to the lingual, care is taken to avoid undercuts with this modification.

5- To prevent areas of stress concentration in the porcelain, be sure that all prepared surfaces are rounded.




Reference: Contemporary Fixed Prosthodontics

# CROWN AND BRIDGE

**Lecture: 12**

# RESIN-BONDED
## *FIXED PARTIAL DENTURES*

**Dr. Farid**

## *INTRUDUCTION*

One of the disadvantages of conventional fixed partial dentures is the destruction of tooth structure required for the abutment preparations upon which the retainers will be placed.
The patient usually asks "it is really necessary to cut away that entire good tooth?" This question troubled dentists in prescribing the replacement of a missing tooth.

Some dentists have tried to minimize the problem by eliminating one of the abutment teeth and fabricating a cantilever fixed partial dentures. While this type of restoration does have its place in carefully selected situations, it is discriminate use can result in failures that are costly both in money spent for subsequent replacement and in loss of periodontal support around previously sound teeth.

Others have tried to use unilateral removable partial denture to avoid undesirable destruction of tooth structure, but these are usually wanting in both retention and stability, and may present the risk of aspiration if they become dislodged.

The development of acid etching of enamel to improve the retention of resin has proven to be a means of attaching fixed partial dentures to teeth by less destructive means.
First trials were consisting of attaching acrylic resin pontic to an unprepared tooth using a composite bonding resin, as intermediate replacement of a missing tooth.

## *METAL FRAMEWORK*

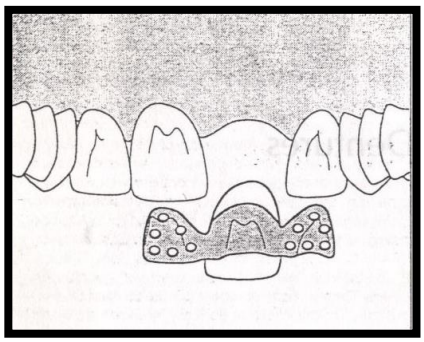
The addition of a metal substructure and "wings" or retainers, extending onto the abutment teeth was a logical progression in the development of the restoration.

### *The Classification of Resin-Bonded Fixed Partial Dentures: -*

1. *ROCHETTE BRIDGE.*
2. *MARYLAND BRIDGE.*
3. *CAST MESH FPD.*
4. *VIRGINIA BRIDGE.*
5. *ADHESION BRIDGE.*

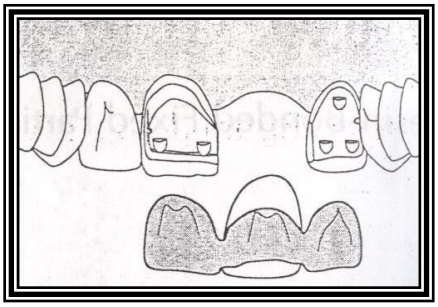
These classifications are reflection of the metal surface finishing technique employed.

## ROCHETTE BRIDGE:



First used by Rochette in 1973. It consists of a wing like retainer attached to the pontic, with funnel-shaped perforations through the wing (retainer) to enhance resin retention (mechanical retention in addition to application of a saline coupling agent to produce adhesion to the metal).
Used for both anterior and posterior fixed partial dentures.

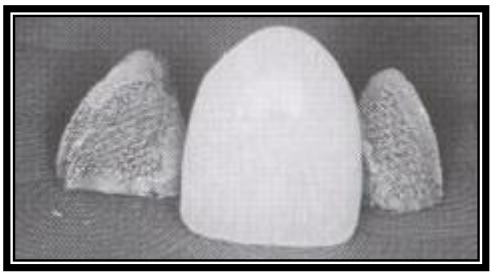
## MARYLAND BRIDGE:

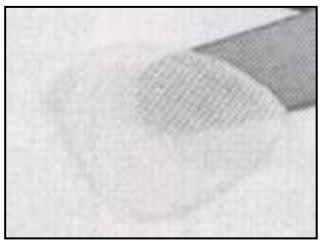


The searchers postulated that the retentive resin extruding through the perforated framework in Rochette design were exposed to increased stresses as well as abrasion and leakage that diminished their longevity.

The new design of the wing is perforation free, and the retention to the resin could obtained by producing micro-spaces in the wing (retainer) internal surface through various ways such as electrochemical pit corroding technique (metal etching).

# CAST MESH FPD:





In this design, they used a non-etching method to produce metal surface roughness before the alloy is cast. A ready made net-like nylon mesh can be placed over the lingual surfaces of the abutment teeth on the working cast. It is then covered by and incorporated into the retainer wax pattern, with the undersurface of the wing (retainer) becoming a mesh-like surface when the retainer is cast.

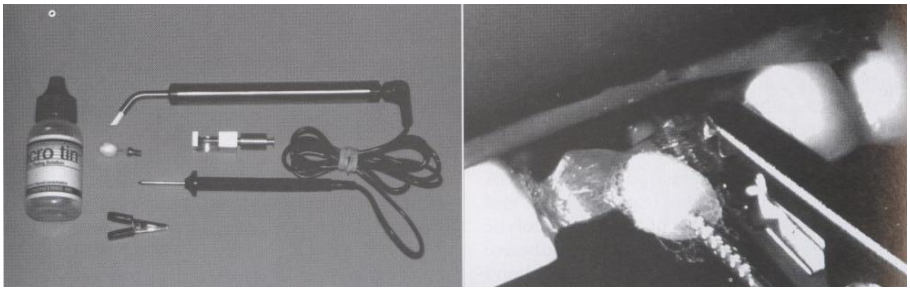
# VIRGINIA BRIDGE:

This design produced particle-roughened retainers by incorporating salt crystals into the retainer patterns to produce roughness on the inner surfaces; this method is known as the lost salt technique for producing Virginia bridges.

The framework is outlined on the die with a pencil, and the area to be bonded is coated first with model spray and then with lubricant, then salt crystals (NACL) ranging in size from 149-250Mm are sprinkled over the outlined area. The retainer pattern is fabricated from resin, leaving a 0.5 to 1.0mm wide, crystal free margin around the outlined area. When the resin has polymerized, the patterns are removed from the cast, cleaned with a solvent, and then placed in water in an ultrasonic cleaner to dissolve the salt crystals. This leaves cubic voids in the surface that are reproduced in the cast retainers, producing retention for the fixed partial denture.

# Adhesion Bridge

In this design there is no need to made any surface modification before casting, after casting, we clean the surfaces with air abrasion, then prepare the retainer inner surface for adhesion by various methods such as tin plating which carried intraorally. The bond in this design depends on the inherent bond ability of the newer resin cement to the alloy.



## *Advantages of Resin-Bonded Fixed Partial Dentures*

1- Reduced cast and chair time by as much as 50 percent.
2- Conservative, minimum tooth structure needs to be removed; the preparation is confined to enamel only.
3- Anaesthesia is not used during tooth preparation (aid to monitor the proximity of the preparation to the DEJ by the patient comfort's level).
4- Supragingival margin is mandatory in resin-bonded fixed partial dentures.
5- The restoration can be rebounded.

## *Disadvantages*

1- Uncertain longevity, the longevity of the prostheses is less than that for conventional prostheses.
2- Irreversible.
3- No space correction, if the edentulous space is wider than the mesiodistal width of the tooth that would normally occupy the space.
4- No alignment correction, good alignment of the abutment teeth is required because the prosthesis's path of insertion is limited by enamel thickness.
5- Difficult temporization.

## *Indications:*

- ***Mandibular incisor replacements***

It is the treatment of choice for replacing one or two missing mandibular incisors when the abutment teeth are undamaged.

- ***Maxillary incisor replacements***

In case of moderate overbite.

- ***Periodontal splint***

The splinting of periodontally involved teeth was the first use of resin-bonded fixed partial dentures.

- **Single posterior tooth replacements**

## *Contraindications*

- ✓ ***Extensive caries***

Because it covers relatively little surface area and relies on bonding to enamel for its retention.

- ✓ ***Deep vertical overbite***

So much enamel must be removed from the lingual surface of a maxillary incisor in this occlusal relationship, the retention would be drastically reduced because of the poor bonding strength afforded by the exposed dentin.

## *Tooth Preparation*

The tooth preparation includes axial reduction and guide planes on the proximal surfaces with a slight extension onto the facial surface to achieve faciolingual lock.

The preparation should encompass at least 180 degrees of the tooth to enhance the resistance of the retainer.

The preparation must be extended as far as possible to provide maximum bonding area, there should be a finish line which is a very light chamfer and should be placed about 1.0 mm supragingivally.

Occlusal clearance which is about O.5mm is needed on maxillary incisors, the thickness of enamel on the lingual surfaces of maxillary anterior teeth are shown in the table.

| Tooth | Millimeters from cementoenamel junction | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Central incisor | 0.3 | 0.5 | 0.6 | 0.7 | 0.7 | 0.7 |
| Lateral incisor | 0.4 | 0.5 | 0.5 | 0.6 | 0.7 | 0.7 |
| Canine | 0.2 | 0.4 | 0.6 | 0.7 | 0.9 | 0.9 |

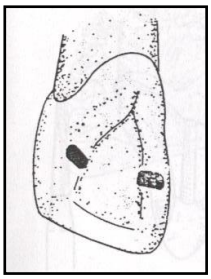
Vertical stops are placed on all the preparations. On the lingual surface of maxillary incisor two or three flat countersinks are placed.

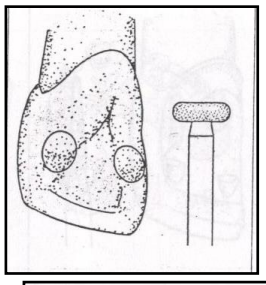
The cingulum rest seat on canine, or an occlusal rest seat on a premolar or molar are contributing to both resistance and rigidity.

The resistance features normally are grooves.

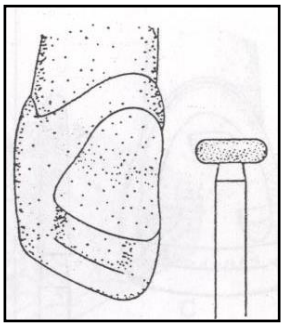
## ***Preparation Sequence***: for maxillary incisor.

1. The centric occlusal contacts are marked with articulating paper. To ensure adequate occlusal clearance in this area, use a small wheel diamond to remove 0.5mm of tooth structure, this step is necessary only on maxillary anterior teeth.

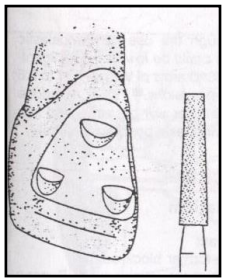




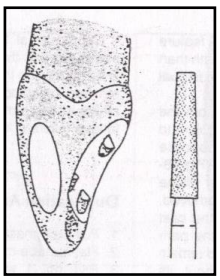
2. Wheel diamond bur is also used to create a concave reduction on the entire cingulum surface, producing 0.5mm of lingual clearance. End this reduction 1.5 to 2.0mm from the incisal edge.



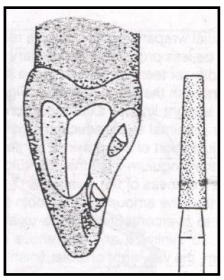
3. Use a flat-end tapered diamond to prepare flat notches or countersinks on the lingual surface of the tooth to provide resistance to gingival displacement.



4. Proximal reduction on the surface adjacent to the edentulous space is done with a tapered diamond, as follows: -

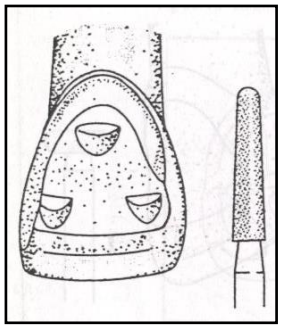


A. Producing a small plane that extends slightly facial to the facio-proximal line angle. This helps produce facial wraparound to enhance resistance.

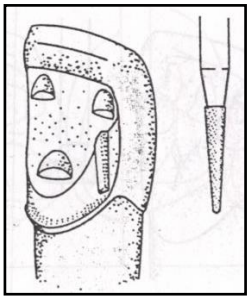


B. A second plane is produced lingual to the first with the same diamond.

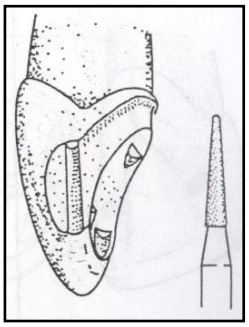
5. Light upright lingual axial reduction is done from bi-planar proximal axial reduction around the cingulum to appoint just short of the proximal contact on the opposite side of the cingulum from the edentulous space.



6. A short groove is placed at the facial most extension of the reduction on the opposite side of the cingulum with a short needle diamond.



The same diamond used to place a groove in the vicinity of the wraparound or break between the facial and lingual planes of proximal axial reduction adjacent to the edentulous space.



Reference: Contemporary Fixed Prosthodontics

# CROWN AND BRIDGE

**Lecture: 13** **Dr. Farid**

## FAILURES IN CROWN AND BRIDGES

Every dentist would like to be able to answer the patient questions: how long will the crown or bridge lost? Because crown and bridge are a custom made device of a daily use and perform their service in a hostile biological environment submerge in water (saliva), and the failures more liable to occur.

Failures can be grouped into 6 categories, with severity increasing from Class I to Class VI

**Class I:** Cause of failure is correctable without replacing restoration.

**Class II:** Cause of failure is correctable without replacing restoration; however, supporting tooth structure or foundation requires repair or reconstruction.

**Class III:** Failure requiring restoration replacement only, supporting tooth structure and/or foundation acceptable.

**Class IV:** Failure requiring restoration replacement in addition to repair or reconstruction of supporting tooth structure and/or foundation.

**Class V:** Severe failure with loss of supporting tooth or inability to reconstruct using original tooth support. Fixed prosthodontic replacement remains possible through use of other or additional support for redesigned restoration.

**Class VI:** Severe failure with loss of supporting tooth or inability to reconstruct using original tooth support. Conventional fixed prosthodontic replacement is not possible.

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- **LOSS OF RETENTION:**

A good diagnostic test for a loose retainer is to examine the bridge carefully without drying the teeth, pressing the bridge up and down and looking for small bubbles in the saliva at the margin of the retainers.

The possible causes of retention loss are:

1- Deformation of the metal cast on the abutment teeth.

2- Inadequate tooth preparation.
3- Bad technique of cementation:
- Inadequate isolation. - Poor mixing or using improper ratio.
- Not removing any remnants that interfere with retention.
- Movement of the patient during cementation.
4- Solubility of the cement due to open margin or perforation in the bridge
5- Caries which cause leakage at the margin.
6- Over much spacer materials on the die.
- When only one retainer become loose without a cement seal, plaque forms in the space between the retainer and the abutment tooth and caries develops rapidly across the whole of the dentine surface of the preparation.

- **MECHANICAL FAILURES OF CROWN AND BRIDGE COMPONENTS**

**Typical mechanical failures are:**

1- Porcelain fracture. 2- Failure of solder joints. 3- Distortion 4- Occlusal wear and perforation. 5- Lost facings.

## 1// Porcelain fracture:

It is fracture of pieces of porcelain in metal ceramic crowns, or the loss of the entire facing due to failure of metal- ceramic bond. It is due to:

**1**- Inadequate thickness of metal.

**2**- Excessive thickness of porcelain contributes to inadequate support predisposes to eventual feature. This is often true in the cervical portion of a pontic.

**3**-The metal surfaces to be veneered not smooth and not free of surface pits or irregularities will cause incomplete wetting by the porcelain slurry, leading to voids at the porcelain metal interface that reduce bond strength and increase the possibility of mechanical failure.

**4-** Sharp angles on the veneering area must be avoided; they produce increased stress concentrations that could cause mechanical failure.

**5-** Excessive occlusal function or trauma.

**6-** Improper laboratory procedures.

**All Porcelain Crown or Bridge Fracture:**

Stresses are developed within porcelain jacket crowns as a result of contraction on cooling after the firing cycle. These Stresses produce failure if the crown is subjected to sufficient force. These Stresses are concentrated around sharp internal angle of fit surface (so should be rounded). If the fracture is due to trauma, and particularly if the restoration had served successfully for some time, it should be replaced by another all ceramic restoration. if the failure occurs during normal function, the replacement should be metal ceramic.

## 2// Failure of solder joints:

Occasionally a solder joint that appears to be sound fails under occlusal loading, this may be due to:

**a)** A flaw or inclusion in the solder itself.

**b)** Failure to bond to surface of the metal.

c) The solder joint not being sufficiently large for the conditions in which it is placed.

A problem, particularly with metal-ceramic bridge work, is that too much restriction of the solder connectors, buccally, gingivally and incisally can lead to inadequate area of solder failure.

It is better to join multiple unit bridges by solder joints in the middle of pontics before the porcelain is added, strengthened by porcelain covering.

There are no satisfactory intraoral repair methods, and it is not possible to re-solder (whole bridge has to be remade).

## 3// Distortion:

Distortion of all metal bridges may occur, for ex. hygienic. Pontics are made too thin or if a bridge removed using too much force when this happen the bridge has to be remade.

In metal ceramic bridges distortion of the framework can occur during function, or as result of trauma. This is likely if the framework is too small in cross section for the length of span and the material used.

## 4// Occlusal wear perforation:

a) In sufficient occlusal preparation lead to less thickness of the metal and this may lead to perforation, which may occur in the finishing and polishing.

b) Even with normal attrition, the occlusal surfaces of teeth wear down substantially over a lifetime.

If perforation has been the result of normal wear and it is spotted before caries has developed, it may be repaired with an appropriate restoration.

## 5// Lost Facings:

Laboratory made ceramic or acrylic facing, may be entirely lost. With acrylic facing, wear and discoloration are also common.

The causes:

1. Poor retention. 2. Heavy occlusion on the facing.
3. The facing is not protected by the metal completely.

- **Changes in the abutment tooth:**

## A\\ Periodontal Disease:

Periodontal disease may be generalized, or in a poorly designed, made or maintained restoration, its progress may be accelerated locally, If the loss of periodontal attachment is diagnosed early enough, and the cause removed, no further treatment is usually necessary.

However, if the disease has progressed to the point where the prognosis of the tooth significantly reduced then the crown or bridge, or the tooth it may have to be removed.

## Most the clinical and laboratory causes are:

1 - Position of the crown margin subgingival margin may have better appearance initially but will often a degree of gingival inflammation which may lead to more serious periodontal disease.

2- Thick margins with poor seating of the restoration and poor axial contour that will ultimately cause periodontal problem.

3- Over margin which lead to a pressure on the gingiva.

4- Coarse or rough margins (not smooth).

5- Remnants of excessive cementing material.

## B\\ Problems with the pulp: -

Great care is needed to prevent pulp injuries during fixed Prosthodontic procedures, the main causes of injury are:

1- Temperature during tooth preparation.

2- Chemical irritation by dental material.

3- Microorganisms. 4- Recurrent caries.

5- More reduction of tooth structure without provisional restoration. Every one of them can cause irreversible pulpits.

## C\\ Fracture of the prepared natural crown or root:

Fractures of the tooth may be occurring as a result of:

1- Trauma. 2- Recurrent caries.

3- Removing the prosthesis intact with using large force.

4- Tooth structure is thin, especially with pulp less teeth (so the post core is necessary).

## D\\ Recurrent caries:

May be due to:

1- Over extension of the margin, will cause plaque formation and periodontal problem due to resorption of the cement which close the space between the cast teeth.

2- Short casting will leave rough cementum or dentin which causes collection of debris.

3- Open margin will allow the saliva and cariogenic organisms to enter between the tooth the restoration.

4- Wearing of the cast will cause resorption of the cement, exposure of the tooth surface which causes caries later on.

5- Looseness of one of the retainers. 6- Poor oral hygiene of the patient.

7- Using a wrong type of retainer.

Dental caries is the most common cause of failure of a cast restoration. Its detection can be very difficult particularly with complete crown.

The caries is often detected only after irreversible pulp involvement had resulted.

Disease may rapidly progress to the point, where tooth loss or the fabrication of a new prosthesis becomes inevitable.

The cause of the problem should be identified dealt with before repair or replacement is started.

- **Design Failures:**

## A)) Abutment preparation

Inadequate crown preparation is a common cause of failures:

1- Taper of preparation when it exceeds 20˚ (ideal 5˚ – 10˚) failure through loss of retention.

**2-** Improper path of insertion lead to the finished restoration can not be seated.

**3-** In sufficient reduction at the margin can result an over built crown produce a plaque retention area at the margin.

**4-** The un rounded external angles of crown preparation man lead to:

a- The stone die materials may not flow into the sharp angles of the impression producing bubbles.

b- The sharp edges may be damaged at the wax up stage.

c- Investment material may not flow adequately into the wax pattern.

d- It may be difficult to remove entirely the investment material from sharp internal angles without damaging the casting.

e- Cement will flow less readily around sharp angles increasing the likelihood of unnecessary thick cement layer at the margins.

## B)) Inadequate bridge Designs:

Designing bridges is difficult; it is neither a precise science nor a creative form of art. It needs knowledge, experience judgment, which takes years to accumulate. Simple classification of these failures is:

***1- Under-prescribed bridges.***

These include designs that are unstable or have too few abutment teeth for ex**:** a cantilever bridge carrying pontics that cover too long span, or a fixed-movable bridge where again the span is too long, or where abutment teeth with too little support has selected.

***2 -Over-prescribed bridges:***

The dentists sometimes include more abutment teeth than are necessary retainer which fails:

* The 1st lower premolar might be included as well as the 2nd premolar 2nd molar in a bridge to replace the lower 1st molar, this is not necessary.

* Upper canines and both premolars on each side are replacing the four incisors. As well as being destructive, or this gives rise to unnecessary practical difficulties in making bridge.

The retainers themselves may be over prescribed with complete crowns being used where partial crowns or intra-coronal retainers would have been quite adequate or metal-ceramic crowns might be used where all metal crowns would have been sufficient.

- **<u>Inadequate clinical or laboratory technique.</u>**

It is helpfully to allocate problems in the construction of crowns and bridges to one of three groups: Minor problems to be noted and monitored but where on action is needed, the type of inadequacies that can be corrected in site, and those that can not.

**1- Marginal Deficiencies:**

**a-** ***<u>positive ledge (overhanq</u>*****):** A positive ledge is an excess of crown material protruding beyond the margin of the preparation. These are more common with porcelain than any other margins. This easy to recognize and correct before the crown then without other-wise disturbing the restoration.

***b- <u>Negative ledge:</u>***

This is deficiency of crown material that leaves the margin of the preparation exposed but with no major gaps between the crown and the teeth. It is a fairly common fault, particularly with metal margins, but that is difficult or impossible to correct at the try-in stage **causes:**

1- The impression did not give a clear enough indication of the margin of the preparation.
2- The die was over-trimmed, resulting in under-extension of the retainer.
3- The die is not separated.

Supragingival margin or just at the margin, it is possible to adjust the tooth surface of the crown.

Subgingival margin can be adjusted with a pointed stone, although this will cause gingival damage. However, the best solution is remade the restoration.

***2- Marginal discrepancy:***

Fitness is the gap between the crown and preparation margins; there are four possible causes of improper fitness:

1. The crown or retainer did not fit and the gap was present at try-in (faults during waxing or impression taking).
2. The crown or retainer fitted at try-in but at the time of cementation the hydrostatic pressure of the cement, particularly if the cement was beginning to set, produced incomplete seating.
3. With a mobile bridge or splint abutment, the cement depressed the mobile tooth in its socket more than the other abutment teeth, thus leaving the gap.
4. No gap was present at time of cementation but one developed following the loss of cement at the margin and crevice has been created by a combination of erosion, abrasion and possibly caries. For these cases, the choice is to remove the bridge, restore the gap with a suitable restoration or leave it alone and observe it periodically.

***3 - Poor shape or color (esthetic problems):***

1. A common mistake in preparing upper incisors for crowns is to remove in sufficient material from the buccal \ incisal third of the preparation. These result in either a crown that is too thin, so that the opaque core material shows through, or in a bulbous crown.
2. Insufficient thickness of porcelain.
3. Too much adjustment is done, the incisal shade of porcelain will be ground away and the esthetic effect spoiled.
4. The stone should be held perpendicular to the junction otherwise the metal particles may contaminate the porcelain.
5. Absent the embrasures will recognize the teeth as artificial
6. Excessive glazed anterior teeth will look unnatural.
7. Inaccurate shade selection.

Any problem in the waxing may create a problem on the final restoration such as:

1. When the wax pattern left of the die lead to distortion because stresses occur in the wax as a result of the heating and manipulation of the wax during fabrication.
2. Wax pattern should be over sized slightly mesiodistally finishing and polishing without creating an open contact in the finished restoration.
3. Most common error relating to axial contour is the creation of bulge or excessive convexity leading to accumulation of food debris plaque causing gingival inflammation, which is encouraged rather than prevented.
4. During the margin finishing, don’t approach the finishing line on the die with sharp instrument that can remove die material causing the final restoration will not fit on the prepared tooth. The margins are a critically area of any wax pattern.

5. Any roughness in the wax near the margin leads to plague irritation and inflammation of adjacent gingival tissues.

***4. Poor investing and casting procedures****:*

1. Vacuum mixing of investment materials highly recommended for obtaining consistent results in casting with no surface defects, especially when phosphate bonded investment are being used.
2. Cooling and reheating of the investment can cause casting inaccuracy, since the refectory and binder will not revert to their original forms. Inadequate expansion and cracking of the investment are typical results.
3. Excessive burn out temperature has led to increased surface roughness on this casting.
4. Alloys from different manufacturers when they mixed even if they are similar leading to defect in the casting. Over heated or otherwise abused alloys as well as grinding and old restorations are best returned to the manufacturer as scarp rather than reused.

***5. Defects in the casting:***

***a- Nodules***: bubbles of gas trapped between the wax pattern and the investment produce nodules on the casting on the casting surface. When they are large or situated in a margin, the restoration should be remade.

***b- Fins***: are caused by cracks in the investment that have been filled with molten metal. These cracks can result from:

1. Weak mix of investment (high water \ powder ratio)
2. Excessive casting force.
3. Steam generated from to rapid heating.
4. Reheating invested pattern.
5. Improperly situated pattern (too close to the periphery of the casting ring).
6. Premature rough handling of the ring after investing.

**c*- Incompleteness***:

1- If an area of wax is too thin (less than 0.3 mm) incomplete casting may result (veneering surface of a metal ceramic restoration).
2- Inadequate heating of the metal.
3- Incomplete wax elimination.
4- Excessive cooling (freezing) of the mold.
5- Insufficient casting force.
6- Not enough metal or metal spillage.

***d- Voids or porosity:***

Voids may be caused by debris trapped in the mold, commonly a particle of the investment. A well waxed small sprue will help prevent them. Porosity resulting from:

1. Solidification shrinkage occurs if the metal in the sprue solidifies before that in the mold, as may happen when a sprue is too narrow, too long, or incorrectly located or a large casting is made in absence a chill vent.
2. Gases may dissolve in the molten alloy during melting leave porosity defects.
3. Back pressure porosity may be caused by air pressure in the mold as the molten metal enters.

Reference: Contemporary Fixed Prosthodontics

# ENDODONTIC

**Lec4** **2023/2024** **د.اياد محمود**

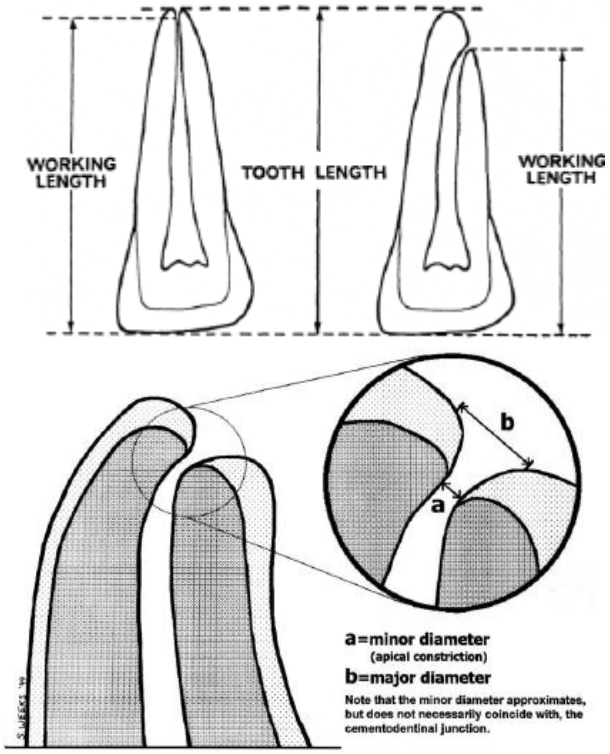
## DETERMINATION OF WORKING LENGTH

**Working length:** is defined as the distance from a coronal reference point to the point at which canal preparation and obturation should terminate, the ideal apical reference point in the canal, the "apical stop," so to speak.

The **anatomic apex** is the tip or the end of the root determined morphologically, whereas the **radiographic apex** is the tip or end of the root determined radiographically. Root morphology and radiographic distortion may cause the location of the radiographic apex to vary from the anatomic apex.

The **apical constriction** (minor apical diameter) is the apical portion of the root canal having the narrowest diameter. This position may vary but is usually 0.5 to 1.0 mm short of the center of the apical foramen. The **minor diameter** widens apically to the foramen **(major diameter)** and assumes a funnel shape.

The **cementodentinal junction:** is the region where the dentin and cementum are united, the point at which the cemental surface terminates at or near the apex of a tooth. It must be pointed out, however, that the cementodentinal junction is a histological landmark that cannot be located clinically or radiographically.




### Clinical Considerations

Before determining a definitive **working length,** the coronal access to the pulp chamber must provide a straight-line pathway into the canal orifice.

Modifications in access preparation may be required to permit the instrument to penetrate, unimpeded, to the apical constriction.

A small **stainless steel** K-file facilitates the process and the exploration of the canal. Working length determination should be to the **nearest one-half millimeter**. The measurement should be made from a secure reference point on the crown, in close proximity to the straight-line path of the instrument, a point that can be identified and monitored accurately.

**Stop Attachments:** A variety of stop attachments are available. Among the least expensive and simplest to use are silicone rubber stops.

**METHODS OF DETERMINING WORKING LENGTH**

**1- Determination of Working Length by Radiographic Methods (Radiographic Apex Location)**

**Materials and Conditions***:*

Advantages of x-ray in endodontic:

1- Aid in the diagnosis and localization of hard tissue alteration of the tooth (sclerosis and resorption) and periradicular structures.

2- Determine the number, location, size, shape and direction of roots and root canals.

3- Estimate and confirm the working length of root canals prior to instrumentation.

4- Determine the relative position of structures in facial or lingual dimensions.

5- Confirm the position and adaptation of filling points.

6- Evaluate by the recall films, the success or failure of endodontic treatment.

The following items are essential to perform this procedure:

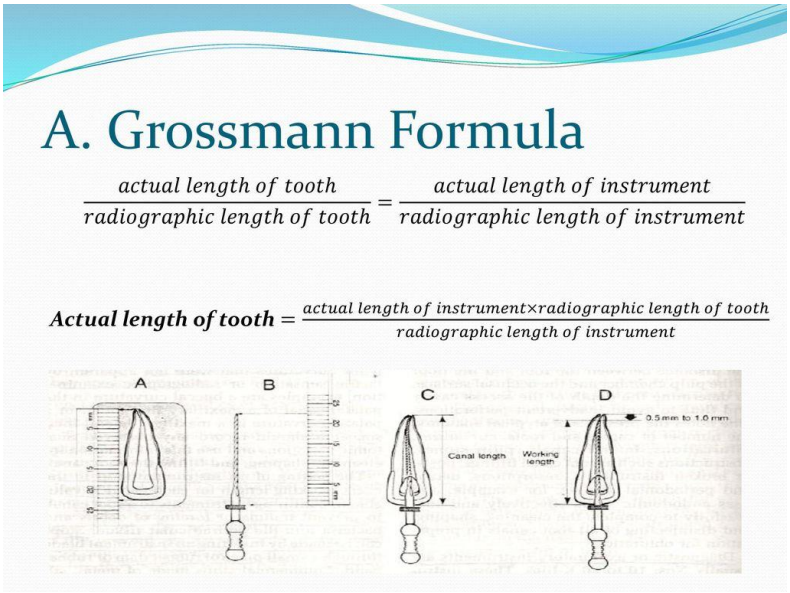
1. Good, undistorted, preoperative radiographs showing the total length and all roots of the involved tooth.
2. Adequate coronal access to all canals.
3. An endodontic millimeter ruler.
4. Working knowledge of the average length of all of the teeth.
5. A definite, repeatable plane of reference to an anatomic landmark on the tooth, a fact that should be noted on the patient's record.

It is imperative that teeth with fractured cusps or cusps severely weakened by caries or restoration be reduced to a flattened surface, supported by dentin. Failure to do so may result in cusps or weak enamel walls being fractured between appointments. To establish the length of the tooth, a stainless steel reamer or file with an instrument stop on the shaft is needed. The exploring instrument size must be small enough to **negotiate** the total length of the canal but large enough not to be loose in the canal. A loose instrument may move in or out of the canal after the radiograph is taken.

**Method**

1. Measure the tooth on the preoperative radiograph.
2. Subtract at least 1.0 mm "safety allowance" for possible image distortion or magnification.

3. Set the endodontic ruler at this tentative working length and adjust the stop on the instrument at that level.
4. Place the instrument in the canal until the stop is at the plane of reference unless pain is felt (if anesthesia has not been used), in which case, the instrument is left at that level and the rubber stop readjusted to this new point of reference.
5. Expose, develop, and clear the radiograph.
6. On the radiograph, measure the difference between the end of the instrument and the end of the root and add this amount to the originally measured length the instrument extended into the tooth, subtract this difference.
7. From this adjusted length of the tooth, subtract a 1.0 mm "safety factor" to conform to the apical termination of the root canal at the apical constriction.
8. Set the endodontic ruler at this new corrected length and readjust the stop on the exploring instrument.
9. If, radiographically, there is no resorption of the root end or bone, shorten the length by the standard 1.0mm. If periapical bone resorption is apparent, shorten by 1.5mm, and if both root and bone resorption is apparent, shorten by 2.0 mm. The reasoning behind this suggestion is thoughtful. If there is root resorption, the apical constriction is probably destroyed, hence the shorter move backup the canal. Also, when bone resorption is apparent, there probably is also root resorption, even though it may not be apparent radiographically.
10. Because of the possibility of radiographic distortion, sharply curving roots, and operator measuring error, a confirmatory radiograph of the adjusted length is highly desirable.
10. When the length of the tooth has been accurately confirmed, reset the endodontic ruler at this measurement.
12. Record this final working length and the coronal point of reference on the patient's record.
13. Once again, it is important to emphasize that the final working length may shorten by as much as 1 mm as a curved canal is straightened out by instrumentation. It is therefore recommended that the "length of the tooth" in a curved canal be reconfirmed after instrumentation is completed.




**2- Accuracy of Working Length Estimation by Direct Digital Radiography or Xeroradiography**

Several studies have evaluated the advantages of using direct digital radiography or xeroradiography for the estimation of working length. The results of the studies indicate that there is no statistically significant difference in working length estimation accuracy between conventional film, direct digital radiography, and xeroradiography. On the other hand, **rapid imaging and reduction in radiation** by these techniques represent a significant advancement in dental radiography.

**3-Determination of Working Length by Digital Tactile Sense**

If the **coronal portion** of the canal is not constricted, an experienced clinician may detect an increase in resistance as the file approaches the apical 2 to 3 mm. This detection is by tactile sense. In this region, the canal frequently constricts (minor diameter) before exiting the root. There is also a tendency for the canal to deviate from the radiographic apex in this region.

**4- Determination of Working Length by Apical Periodontal Sensitivity**

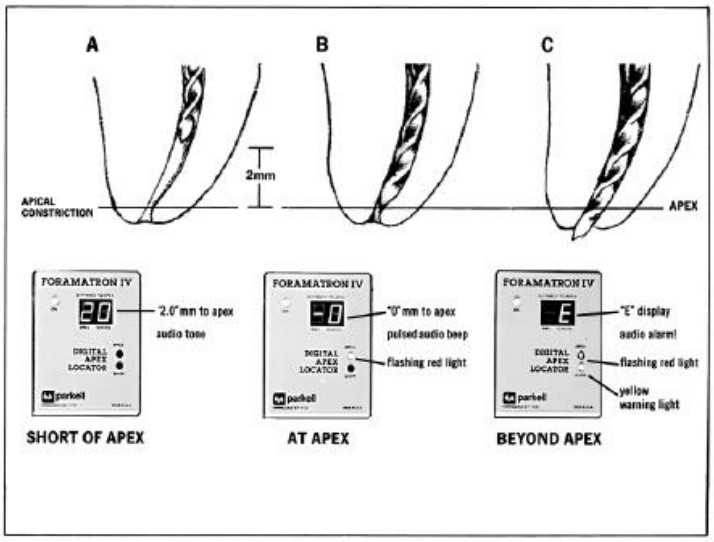
If an instrument is advanced in the canal toward **inflamed tissue**, the hydrostatic pressure developed inside the canal may cause moderate to severe, instantaneous pain. At the onset of the pain, the instrument tip may still be several millimeters short of the apical constriction. When pain is inflicted in this manner, little useful information is gained by the clinician, and considerable damage is done to the patient's trust.

**5- Determination of Working Length by Paper Point Measurement**

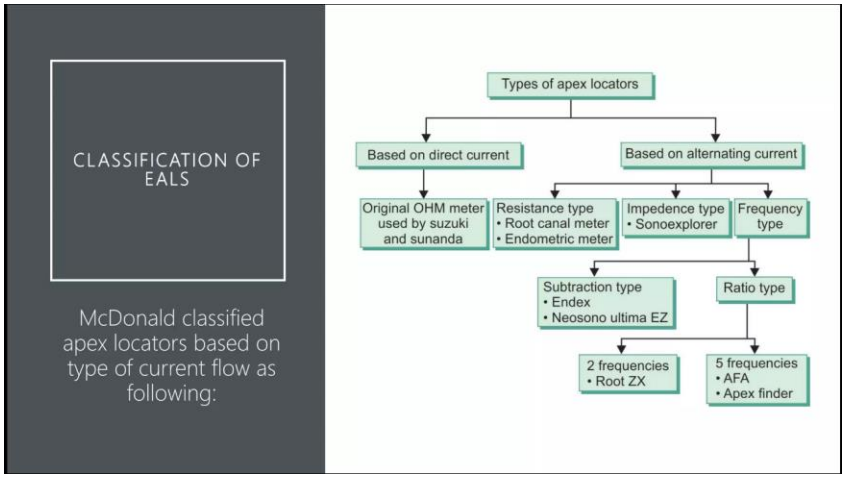
In a root canal with an immature (wide open) apex, the most reliable means of determining working length is to gently pass the **blunt end** of a paper point into the canal after profound anesthesia has been achieved. The moisture or blood on the portion of the paper point that passes beyond the apex may be an estimation of working length or the junction between the root apex and the bone.

## 6- Determination of Working Length by Electronics (apex locators)

These devices all attempt to locate the apical constriction, the cement-dentinal junction, or the apical foramen. They are not capable of routinely locating the radiographic apex. All apex locators function by using the human body to complete an electrical circuit. One side of the apex locator's circuitry is connected to an endodontic instrument. The other side is connected to the patient's body, either by a contact to the patient's lip or by an electrode held in the patient's hand. The electrical circuit is complete when the endodontic instrument is advanced apically inside the root canal until it touches periodontal tissue. The display on the apex locator indicates that the apical area has been reached.




Modern electrical apex locator that displays **A**, by digital readout, distance of the file tip to the cementodentinal junction in tenths of millimeters; **B**, "O" reading, flashing red light, and pulsing tone when the cementodentinal junction is reached. **C**, If the apical constriction is penetrated, a yellow warning light flashes, a visual "E" (error) is displayed, and an audio alarm warns the dentist



# Endodontics2023-2024

Lecture ٥/ 5TH stage L. AYAD MAHMOOD

# Intracanal Instruments 1

## Classification of intracanal instruments[1-3]

They are divided into six groups:

Group I: Manually-operated instruments, such as barbed broaches and K type and H type instruments.

Group Il: Low-speed instruments with a latch-type attachment. Typical instruments in this group are Gates-Glidden (GG) burs and Peeso reamers. They are typically used in the coronal part of the canal and never used in a canal curvature.

Group III: Engine-driven nickel-titanium rotary instruments. They consist of a rotating blade that can safely be operated in, and adapt itself to curved root canals. Most engine-driven instruments available today belong to this group.

Group IV: Engine-driven instruments that adapt themselves three-dimensionally to the shape of the root canal. Like other nickel-titanium instruments, they adapt to the shape of the root canal longitudinally but additionally they adapt also to the cross-section of the root canal. There is currently only one instrument in this group: the self- adjusting file (SAF).

Group V: Engine-driven reciprocating instruments.

Group VI: Ultrasonic instruments.

## Group I: Manually-operated instruments.

Barbed Broaches They were the earliest endodontic instruments used to extirpate the pulp. They are manufactured by hacking a round, tapered wire with a blade to form sharp, projecting barbs that cut or snag tissue. A barbed broach does not cut or machine dentin; this instrument is mostly used to engage and remove soft tissue from the canal. It is an excellent tool for removing cotton or paper points that have accidentally become lodged in the root canal.

K-type instruments. The K-file and K-reamer are the oldest useful instruments for cutting and machining dentin. They are made from a stainless steel wire that is ground to a tapered square or triangular cross-section and then twisted to create either a file or a reamer. A file has more flutes per length unit than a reamer. K-type instruments are useful for penetrating and enlarging root canals.

The instrument works primarily by compression- and-release destruction of the dentin surrounding the canal. Generally, a reaming motion (constant file rotation) causes less transportation than a filing motion. Transportation is the excessive loss of dentin from the outer wall of a curved canal in the apical segment. As the instrument is increased in width its flexibility is decreased.

K-flex file It has a cross-section that is rhomboid in shape. It is a twisted instrument and has a series of cutting flutes. It has 2 acute edges and 2 obtuse edges. The acute angle cuts into the dentin while the obtuse angle provides more area for debris collection and removal. The cutting efficiency and flexibility is greater than the K-type file.

Flex-O-File _This instrument resembles the K-type file but it is triangular in cross-section. There is better cutting action and more room for the debris, better flexibility and more resistance to fracture. The tip of the instrument is non-cutting so no apical ledge formation is possible.

Flex-R- file
The design of the tip of this instrument eliminates the possibility of ledge formation by removing the cutting surface of the tip's leading edge. This guides the instrument in the canal rather than cut. It has a triangular cross-section which increases its flexibility. It cuts more efficiently in anti-clockwise motion and can be used for filing action.

H-type instruments.
An H-type instrument has spiral edges arranged to allow cutting only during a pulling stroke. An example is a Hedstrm file. An H- type instrument is better for cutting than a K- type instrument, because it has a more positive rake angle and a blade with a cutting rather than a scraping angle. Bending a Hedstrm file results in points of greater stress concentration than occurs with K-type instruments. These concentration points can lead to the propagation of cracks and fatigue failure. All H-type instruments are ground from a tapered blank. Hedstrm files are formed by grinding a single continuous flute.

S-file (Uni-file)
This instrument is a ground S-shaped cross-section instrument. This is stiffer than the Hedstrom file. The cutting mode may be with filing or reaming action.

## Traditional instrument modifications

1- Nickel titanium file.

Files made from nickel titanium showed greater elastic flexibility and resistance to torsional fracture than stainless steel. This file has a non-cutting tip and it tends to maintain the curvature of the root canal.

2- Golden mediums

These instruments are a series of intermediate size instruments. They correspond in size to halfway between standard ISO sizes and correspond to 12, 17,22,27,32 and 37 in number.

3- Canal Master U

This hand instrument is used to prepare the apical third of the canal. It has a non-cutting pilot tip, 1 mm length cutting blade and a narrow parallel sided shaft. It is used to allow for better cutting with more space for debris accumulation and further removal. It reduces the possibility of ledge or transportation.

## Group II: Low Speed Rotary Instruments

Many types of rotary instruments are used during endodontic procedures. In addition to conventional burs, burs with extended shanks for low-speed contra-angle handpieces are useful for providing good visibility during deep preparation of the pulp chamber. This is particularly important when using an operating microscope when performing such procedures after access to the pulp chamber has been achieved. Straight-line access to the initial point of curvature can be accomplished using rotary instruments such as Gates-Glidden burs and Peeso instruments. Use of these instruments should be limited to the straight portion of the canal preparation. The risk of perforation with these instruments is a possibility. The risk of lateral cutting resulting in perforation is lower with Gates-Glidden burs than with the Peeso drills. The Peeso reamer is used mostly for post space preparation.

## Group III: Rotary Instruments for Canal Preparation

Components of file

1 - The taper. It is expressed as the amount the file diameter increases each millimeter along its working surface from the tip toward the file handle for example, a size #25 file with a #.02 taper would have a 0.27 mm diameter 1 mm from the tip a 0.29 mm diameter 2 mm from the tip, and a 0.31 mm diameter 3 mm from the tip. Some manufacturers express the taper in terms

of percentage (e.g., a #.02 taper is a 2% taper).
2- The flute of the file. It is the groove in the working surface used to collect soft tissue and dentin chips removed from the wall of the canal. The effectiveness of the flute depends on its depth, width, configuration, and surface finish.
3- Helix angle. It is the angle the cutting edge forms with the long axis of the file. It gathers debris collected in the flute from the canal. This angle is important for determining which file technique to use.
4. If a file is sectioned perpendicular to its long axis, the rake angle is the angle formed by the leading edge and the radius of the file. If the angle formed by the leading edge and the surface to be cut (its tangent) is obtuse, the rake angle is said to be positive or cutting. If the angle formed by the leading edge and the surface to be cut is acute, the rake angle is said to be negative or scraping.
5- The pitch of the file is the distance between a point on the leading edge the corresponding point on the adjacent leading edge. The smaller the pitch or shorter the distance between corresponding points, the more spirals the file has the greater the helix angle.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# Endodontics 2023-2024

Lecture 6/ 5th stage L. AYAD MAHMOOD

Intracanal Instruments 2

## Rotary Instrumentation systems using Nickel Titanium[1-3]

| TABLE Generations of NiTi Systems According to Haapasalo and Chen[150] | |
|---|---|
| **1st generation** | ProFile, GT |
| • 1992 McSpadden | Quantec |
| • 1994 B. Johnson | LightSpeed |
| .02, .04 and .06 taper, radial lands, pass, flutes | |
| **2nd generation** | ProTaper, K3 |
| active flutes without radial lands | FlexMaster, BioRaCe |
| → less instruments needed | |
| **3rd generation** | HyFlex, K3XF, Vortex |
| • 2007 M-wire | Vortex, Vortex blue |
| • 2010 R-phase | Twisted Files |
| • 2010 CM wire | |
| **4th generation** | Reciproc, SAF |
| • 2008 Yared | WaveOne |
| • 2011 Wave One, Reciproc reciprocal motion | |
| **5th generation** | OneShape |
| **asymmetrical cross-section** | Revo-S, PT Next |

## ProFile system

The ProFile system was introduced in 1994. ProFile instruments have increased tapers compared with conventional hand instruments.
The tips of the ProFile Series 29 rotary instruments had a constant proportion of diameter increments (29%). Cross section of a ProFile instrument has a U-shape design with radial lands. Lateral views show a 20-degree helix angle, a constant pitch, noncutting tips and with a neutral or slightly negative rake angle. This configuration facilitates a reaming action. The preferred speed is 275-325 rpm.

## ProFile GT Files.

The Greater Taper (GT) file was introduced in 1994. This instrument also has the U-shape file design. The instruments comes in four tapers (0.06, 0.08, 0.10, and 0.12), and the maximum diameter of the working part coronally is 1 mm. The instruments have a variable pitch and an increasing number of flutes in progression to the tip; the apical instrument diameter is 0.2 mm. Instrument tips are noncutting and rounded.

## ProTaper Universal system.

The ProTaper system is based on another concept and composed of six instruments:
1- Three shaping files.
.2- Three finishing files.
This set is increased by two larger finishing files and a set designed for retreatment procedures.in cross section, ProTaper shows a modified K-type file with sharp cutting edges and no radial lands: this creates a stable core and sufficient flexibility for the smaller files. The cross section of finishing files F3, F4, and F5 is slightly relieved for increased flexibility. The difference in design of this system is the varying tapers along the instruments' long axes. The three shaping files have tapers that increase coronally, and the reverse pattern is seen in the five finishing files.

Shaping files #1 and #2 have tip diameters of 0.185 mm and 0.2 respectively, 14-mm-long cutting blades. The diameters of these files at D14 are I.2 and I.1 mm, respectively. They are used in the coronal and middle third of the root canal.

The finishing files (Fl-F5) have tip diameters of 0.2, 0.25, O3,0.4. C and 0.5 mm, respectively, between D0 and D3, and :the apical tapers are .07, .08, .09, .05, and .04, respectively. The finishing files have rounded noncutting tips. They are used in the apical third of the root canal.
The convex triangular cross section of ProTaper instruments reduces the contact areas between the file and the dentin. The greater Cutting efficiency of this design has been improved by balancing the pitch and helix angle, preventing the instruments from threading into the canal. ProTaper instruments can be used with 250 to 300 rpm.
Two usage characteristics are recommended for the ProTaper system:
1 -The preparation of a glide path.
2- The use of a more lateral "brushing" Working stroke. Such a stroke

allows the Clinician to direct larger files coronally away from danger zones and counteracts any “threading-in” effect.

## RaCe, Bio Race

The RaCe was manufactured since 1999 by FKG. The name stands for reamer with alternating cutting edges. This design aimed at reducing the tendency to thread the file into the root canal. Cross sections are triangular or square for #.02 instruments with size #15 and #20 tips. The surface quality of RaCe instruments is done by electropolishing. The tips are round and noncutting.

## **Twisted File.**

In 2008, the first fluted NiTi file was introduced and manufactured by plastic deformation, a process similar to the twisting process that is used to produce stainless steel K-files. This is done when a thermal process allows twisting during a phase transformation into the “R-phase” of nickel-titanium. The instrument is available with size #25 tip sizes only, in taper .04 up to .12. This production process resulted in superior physical properties.

## ProTaper Next

This system is composed of 5 files, namely X1, X2, X3, X4 and X5.
These files Corresponds to sizes 20/04, 25/06, 30/07, 40/06 and 50/06 respectively.
The X1 and X2 have variable tapered design whereas X3-X5 files have a fixed taper from D 1 -D3 then a decreasing percentage tapered design over the rest of their active portions.
This system has a rectangular cross section that is off centered which allows 2 points contact with the dentin wall and the rest of the space free for storing debris which will be removed by the file swaggering motion.

## Wave One single file reciprocating system

This system is a single-use, single file system to shape the root canal. In most cases, the technique only requires one hand file followed by one single Wave One file to shape the canal completely using the reciprocation motion that engages and cut dentine in a 150-degree counter-clockwise (CCW) direction and then, before the instrument has a chance to taper lock, disengages 30 degrees in a clockwise (CW) direction. The net file movement is a cutting cycle of 120 degrees and therefore after three cycles the file will have made a reverse rotation of 360 degrees.
The file is made with M-wire technology which improves strength and

resistance to cyclic fatigue about four times the traditional rotary NiTi files. The system is composed of:
- The Wave One small file. It is used in narrow canals. The tip has an ISO of 20 with a continuous taper of 6%.
-The Wave One primary file. It is used in the majority of canals. The tip has an ISO of 25 with an apical taper of 8% that reduces towards the coronal end.
- The Wave One large file. It is used in wide canals. The tip has an ISO of 40 with an apical taper of 8% that reduces towards the coronal end.
The instruments are designed to work with a reverse cutting action. All instruments have a modified convex triangular cross section at the tip end and a convex triangular cross section at the coronal end. This design improves instrument flexibility. The variable pitch flutes along the length of the instrument improve safety.

## XP Endo shaper

It is rotary file system made with MaxWire alloy which offers better:
1 - Flexibility
2- Fatigue resistance
3- Ability to progress within the canals with ease, expanding or contracting according to the canal morphology.
4- Shape memory principles enabling the instrument to take on a predefined shape at 35°C.
The instrument has the Booster Tip which has the following properties:
I - Six cutting edges for optimal guidance.
2- Starts shaping at minimum ISO diameter 1 5 to achieve a final diameter of ISO 30 with only one instrument. It increases the taper from .01 to at least .04. It allows reaching a final canal preparation of minimum 30/.04 with only one instrument.

## Group IV: Engine—Driven Three-Dimensionally Adjusting Files (Self adjusting file)

The se1f adjusting file (SAF) represents a new approach in file design and mode of operation.
The file is a hollow device, designed as a cylinder of thin-walled delicate NiTi lattice with a lightly abrasive surface. An initial glidepath is established with#20 K-file to allow the insertion of the SAF file.

The file compresses from its 1.5 mm diameter into dimensions equivalent to those of a #25 K-file. The handpiece generates in-and-out vibrations with 5000 vibrations per minute and 0.4 mm amplitude. The compressed file will adapt itself to the root canal walls, applying a uniform cutting action gradually removing a uniform dentin layer from the canal walls. There a continuous flow of irrigant which removes the tissue debris and the dentin powder generated by the file.

## Group V: Engine-Driven Reciprocating Instruments:

The Giromatic handpiece, a rotary instrument in use since 1 969, delivers 3000 quarter-turn reciprocating movements per minute. Rasps and barbed broaches are most often used in Giromatic handpieces, but K-type and H-type instruments also can be used.

## Group VI: Sonic and Ultrasonic Instruments

Files or ultrasonic tips can be activated by electromagnetic ultrasonic energy. This energy activates an oscillating sinusoidal wave in the file with a frequency of upto 30 kHz.

There are two types of such energy:

1 - Ultrasonic: Devices which operate at 25 to 30 kHz, include the magnetostrictive and the piezoelectric. Ultrasonic devices use regular types of instruments (e.g., K-files),

2- Sonic: Devices which operate at 2 to 3 kHz which may use metal files or plastic tips as Endoactivator.

Although similar in function, piezoelectric units have some advantages over the magnetostrictive systems. For example, piezoelectric devices generate little heat, so no cooling is needed for the electric handpiece. The magnetostrictive system generates excessive heat, and a special cooling system is needed in addition to the irrigation system for the root canal.

The file in an ultrasonic device vibrates in a sinus wave like fashion. A standing wave has areas with maximal displacement (i.e., antinodes) and areas with no displacement (i.e., nodes). The tip of the instrument exhibits an antinode. Ultrasonic devices proved very efficient for irrigating root canal systems.

During free ultrasonic vibration in a fluid, two effective physical effects are formed:

1 - Cavitation. During oscillation in a fluid, a positive pressure is followed by a negative pressure causing implosion.

2- Acoustic streaming: This is small, intense, circular fluid movement around the instruments.

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lec.7 د. اياد محمود

# Restoration of Endodontically Treated Teeth

Teeth requiring endodontic treatment need to be assessed restoratively prior to initiating endodontic care. The canals may be identified, instrumented, and obturated successfully, but if the tooth cannot be predictably restored, the clinical success is guarded.

- Although there has been a recent trend in endodontic research to promote conservative access and canal preparation, the fact remains that some loss of tooth structure does occur even with conservative endodontic treatment techniques.

- Although an adequate coronal seal may be provided by a well-obturated root canal system, over time an inadequate coronal restoration may allow for the ingress of microbes and contribute to the recontamination and ultimate failure of the endodontic and restorative treatment. the effect of the restoration on the success was statistically greater than the effect of a good endodontic filling.

After endodontic treatment, restoration of root filled teeth can be challenging due to structural differences between vital and non-vital root filled teeth. Irreversible chemical—physical (dehydration of dentin; reduction of micro-hardness; collagen alteration; effects of irrigants and medicaments) and especially bio-mechanical changes (loss of tooth structure; loss of proprioception), due to the endodontic treatment, increase the propension to dental fracture and condition the restoration options for the clinician. Restoring a tooth after endodontic treatment needs to conserve as much remaining tooth structure as possible. Posterior teeth should be restored with restorations that cover and protect the occlusal surface of the tooth as onlay. Crown coverage of teeth is only indicated when the tooth has multiple large restorations or it lost great amount of tooth structure.

Types of treatments according to tooth loss

1- Direct Composite Restorations

When a minimal amount of coronal tooth structure has been lost after endodontic therapy, a direct resin composite restoration can be done. Composites have compressive strengths of about 280 MPa, and the Young modulus of composite resins is generally about 10 to 16 GPa, which is close to that of dentin.

Endodontic treatment that has both marginal ridges intact and only the endodontic access is not native tooth structure or a very limited occlusal restoration was present may be restored with an adhesive composite as the final restoration. Those teeth may be treated by removal of the obturation material to the canal orifice or several millimeters apical to the canal orifice, followed by an adhesively bonded composite restoration. Any preparation that is deeper than 6 mm will not permit adequate light intensity from the curing light to complete polymerization of the resin in the preparation. Due to the depth of the composite to be placed, use of a dual-cure resin is recommended to ensure complete curing of the resin. Utilization of an adhesive that is either self-cure or has a dual-cure promoter is also recommended, as the curing light may be unable to reach the depths of the preparation and leave uncured adhesive, limiting the bond of the overlaying composite to the remaining dentin. Since self-cure and dual-cure composites often are more opaque when set, esthetics may be improved by overlaying the final 2 mm with a light-curable composite if required or desired.

2- Indirect Restorations: Composite or Ceramic Onlays.

Ceramic or resin composite onlays can be used to restore endodontically treated teeth. Endocrowns combine the post in the canal, the core, and the crown in one component.

Both onlays and endocrowns allow for conservation of remaining tooth structure, whereas the alternative would be to completely eliminate cusps and perimeter walls for restoration with a full crown.

Onlays are constructed in the laboratory from either hybrid resin composite or ceramics. Onlays, overlays, and endocrowns can also be fabricated from resin composites processed in the laboratory. Using various combinations of light, pressure, and vacuum, these fabrication techniques may increase the conversion rate of the polymer and consequently the mechanical properties of the restorative material.

There is no clear evidence to favour ceramic or composite resin inlays, but composite resin onlays—overlays are, in general, less expensive and easier to prepare and repair.

When one marginal ridge is intact but the other is missing, a restoration that will limit cuspal flexure is indicated. If the missing tooth structure at the center of the occlusal surface is less than one-third of the buccal-lingual width of the tooth, an onlay may be chosen for restoration of the tooth, as this provides cuspal shoeing that will limit flexure and potential cuspal fracture.

Premolars have a narrower mesial-distal dimension than molars and are more prone to cuspal fracture when the marginal ridges are not native tooth structure.

3- Full Crowns

when a significant amount of coronal tooth structure has been lost by caries, restorative procedures and endodontics, a full crown may be the restoration of choice.

The crown can be directly built on the remaining coronal structure which has been prepared accordingly. More frequently, the cementation of a post inside the root canal is necessary to provide retention for the core material and the crown. The core is anchored to the tooth by extension into the root canal through the post and replaces missing coronal structure. The crown covers the core and restores esthetics and function of the tooth. An additional role of the post and core is to protect the crown margins from deformation under function therefore preventing coronal leakage. The post and its luting material used to cement it, the core and the crown will all influence the longevity of the tooth.

When a post is needed it gives retention to the core but it does not strengthen the tooth against fracture especially metal posts. Adequately condensed gutta-percha can be safely removed immediately after endodontic treatment. Both rotary and hot instruments can be safely used to remove gutta-percha. Tapered posts are the least retentive posts and threaded posts are the most retentive but these threads increase the possibility of stress concentration at the edges of the post and end in root fracture.

When greater than one-third of the occlusal width is missing, or both marginal ridges are not native tooth structure, a fullcoverage crown is the best restoration. In those situations, typically a post is needed to retain the core, as minimal tooth structure will be present following preparation for a crown. The practitioner may view the tooth as having sufficient tooth structure so that a post is not required, but the remaining native tooth structure lies on the buccal and lingual of the tooth, and the majority of this will be removed with the crown preparation.

The cuspal coverage amalgam restoration,and  a composite restoration covering the cusps has also been suggested as an alternative to a crown for endodontically treated posterior teeth. In a laboratory study examining the fracture resistance of endodontically treated molars with direct or indirect cuspal coverage composite restorations, found that restoring all cusps with

composite significantly increased the fracture resistance. Therefore, reducing the entire occlusal surface and all cusps 2 mm and restoring the tooth in composite may offer a suitable option for restoring endodontically posterior teeth especially in the premolar region where a metallic restoration may not be as esthetically acceptable. However, a review of the literature indicates that amalgam is superior to composite for posterior tooth restorations in terms of long-term survivability of the restoration. This may again indicate that a cuspal coverage composite may reinforce the strength of the tooth and serve as a good transitional restoration until a crown can ultimately be placed to protect the tooth long term.

## The Ferrule

A ferrule effect is defined as a $360^0$ metal collar of the crown surrounding the parallel walls of the dentine extending coronal to the shoulder of the preparation. The result is an elevation in resistance form of the crown from the extension of dentinal tooth structure before any core material begins.
If the clinical situation does not permit a circumferential ferrule, an incomplete ferrule is considered a better option than a complete lack of ferrule.
The more tooth structure that remains, the better the long-term prognosis of the restoration. The coronal tooth structure located above the gingival level will help to create a ferrule. The ferrule is formed by the walls and margins of the crown, encasing at least 2 to 3 mm of sound tooth structure. A properly made ferrule significantly reduces the incidence of fracture in endodontically treated teeth by reinforcing the tooth at its external surface and dissipating forces that concentrate at the narrowest circumference of the tooth. A longer ferrule increases fracture resistance significantly. The ferrule also resists lateral forces from posts and leverage from the crown in function and increases the retention and resistance of the restoration.

In teeth with no coronal structure, in order to provide a ferrule, the clinician may consider two options: surgical crown lengthening or orthodontic extrusion. In such a clinical situation, an adequate ‘‘biologic width’’ and distance between crown margin and alveolar crest should be ensured. Biological width was defined as ‘‘the dimension of the junctional epithelial and connective tissue attachment to the root above the alveolar crest’’.

A minimum of at least 3 mm should be left between the crown margin and the alveolar bone in order to avoid impingement on the coronal attachment

of the periodontal connective tissue. In consideration of the restorative dimension then required, at least 3 mm of supra-alveolar tooth structure, in addition to ferrule height, may be required to provide an effective restorative dimension

Requirements of crown shape and crown preparation;
1. The ferrule (dentin axial wall height) must be at least 2 to 3 mm.
2. The axial walls must be parallel.
3. The restoration must completely encircle the tooth.
4. The margin must be on solid tooth structure.
5. The crown and crown preparation must not invade the adjacent tissues.

## Posts

A post is a rigid restorative device placed in the radicular portion of non-vital teeth. During the restoration of an endodontically treated tooth, a post may be required. Its success depends on the quality of endodontic treatment, shape of the canals, status of the remaining tooth structure, and the periodontal support available.
Dentin has a degree of flexibility and posts can be flexible material can behave exactly like dentin, a post with functional behavior similar to that of dentin is beneficial when the post must be placed next to dentin.
Fiber posts have a modulus of elasticity closer to dentin than that of the metal posts. An ideal post should be resilient enough to cushion an impact by stretching elastically, thereby reducing the resulting stress to the root. It would then return to normal without permanent distortion. Therefore, the perfect post would combine the ideal degree of flexibility and strength in a narrow-diameter structure.

Clinical guidelines for post dimension
1- The post should be 3/4 the length of the root when treating long rooted teeth or keeping 5 mm of apical gutta-percha.
2- The post should be confined to the straight part of the root canal.
3- Post width should be as wide as the width of the treated root canal without extra widening to keep as much tooth structure as possible.

## Classification of posts

1- Custom made posts (gold or base metal alloys)
2- Prefabricated posts

a) Metal (gold, stainless steel or titanium posts)
b) Carbon fiber
c) Glass fiber
d) Quartz
e) Zirconia

Posts should provide as many of the following clinical features as possible:

1- Maximal protection of the root from fracture
2- Maximal retention within the root and retrievability
3- Maximal retention of the core and crown
4- Maximal protection of the crown margin seal from coronal leakage
5- Pleasing esthetics, when indicated
6- High radiographic visibility
7- Biocompatibility

Procedure for post space preparation and post placement

1- Take an x ray to evaluate the condition, length and width of the tooth.
2- Preserve as much as possible of the tooth structure coronally but at the same time offers an easy access of the Pesso drill to the root canal.
3- The gutta-percha is removed by the Pesso drill with as minimum tooth structure removal as possible.
4- A suitable sized post should be placed to fit the space in the root canal.
5- The post is cemented in the root canal with a luting agent (composite luting cement or glass ionomier cement) in the root canal.
6- The core is built up with a suitable material as composite or amalgam.

The material used to lute the post into the root is dependent on the type of post. A luting material that works with metallic posts may not be recommended for fiber posts. It is universally recommended that fiber posts require luting with a resin material. Glass ionomer does not provide adhesion between the cement and post of sufficient bond strength to prevent disruption of the interface under function. Glass ionomer cements do not provide adequate pull-out strength of the post from the tooth and may lead to restorative failure over time. Resin cements have been reported to provide twice the pull-out strength of glass ionomers. With this in mind, use of resin cement is recommended when placing a fiber post.

# Endodontics 2023-2024

Lecture 8 /5th stage L. AYAD MAHMOOD

# Root canal filling materials[1, 2]

Sealers

They are paste like material that is essential to seal the space between the dentinal wall and the gutta-percha.

Functions of the root canal sealer:

1- Cementing the core material to the canal wall.
2- Filling and marking irregularities that cannot be filled by gutta-percha (lateral and accessory canals).
3- Act as a lubricant to ease the placement of the master cone.
4- Act as a bactericidal agent.

Properties of an ideal Sealer:

1- Exhibits tackiness when mixed to provide good adhesion.
2- Produce a hermetic seal.
3- Radiopaque.
4- Very tine powder to get a smooth mix with the liquid.
5- No shrinkage on setting.
6- No staining of tooth structure.
7- Bacteriostatic.
8- Exhibits a slow set.
9- Insoluble in tissue fluids.
10- Tissue tolerant.
11- Soluble in common solvents.

Zinc Oxide and Eugenol:

Zinc oxide-eugenol sealers have been used for many years. They have certain properties as:

1- Exhibit a slow setting time.
2- Shrinkage on setting.
3- Solubility especially when extruded outside the root canal.
4- Stain tooth structure.
5- It has antimicrobial activity.

Types of zinc oxide eugenol sealers:
1- Rickert sealer. This powder/liquid sealer contains silver particles for radiopacity. It stains tooth structure if not completely removed. This sealer is popular when using thermoplastic techniques.
2- Procosol sealer. It is a modification of rickert's formula in which the silver particles have been removed.
3- Roth's sealer. This is a modification of the Rickert' sealer as it is no staining.
4- Tubli-Seal. It is a catalyst/base zinc oxide-eugenol sealer. It has a faster setting time when compared with the liquid/powder sealers.

Calcium Hydroxide Sealers:-
They were developed for their antimicrobial activity and osteogenic-cementogenic potential. These actions were very limited. From the types of this group are Sealapex (catalyst/base system), Apexit and Apexit Plus.

Noneugenol Seaters:-
They are root canal sealers without the irritating effects of eugenol.

Glass lonomer Seaters:-.
The glass ionomers have been developed in root canal obturation because of their dentin-bonding properties. An example from this group is Ketac-endo.

Properties of this group:
1- It enables adhesion between the material and the canal wall.
2- It is difficult to properly treat the dentinal walls in the apical and middle thirds with modifying agents to receive the glass ionomer sealer.
3- It has minimal antimicrobial activity.

Epoxy resin sealers.
These sealers provide adhesion, and do not contain eugenol.
Types of this group are:
1- Ah-26. It is a slow-setting epoxy resin that releases formaldehyde when setting.
2- Ah Plus. It is a modified formulation of Ah-26 in which formaldehyde is not released. It exhibits a working time of approximately 4 hours.
3- EndoreZ. It is a methacrylate resin with hydrophilic properties. When used with endoreZ resin-coated gutta-percha cones the dual cure endoreZ sealer bonds to both the canal walls and the core material.
4- Diaket. It is a polyvinyl resin sealer.

5- Epiphany and RealSeal. They were introduced for use with the resilon filling material.

Silicone Sealers.

1- RoekoSeal is a polyvinylsiloxane that is supposed to expand slightly on setting.
2- GuttaFlow is a cold flowable matrix that is triturated. It consists of gutta-percha added to roekoSeal. Sealing ability is comparable to other techniques.

Bioceramic sealers.

It is composed of zirconium oxide, calcium silicates, calcium phosphate monobasic, calcium hydroxide, and various filling and thickening agents.

Properties of this group:

1- It is a hydrophilic sealer it utilizes moisture within the canal to complete the setting reaction.
2- It does not shrink on setting.
3- It is biocompatible.
4- It exhibits antimicrobial properties during the setting reaction.

Semi Rigid types materials for obturation of the root canal

1- Gutta-Percha

Gutta-percha is the most commonly used root canal filling material. It is a linear crystalline polymer that melts at a set temperature, with a random but distinct change in structure resulting. It occurs naturally as 1, 4-polyisoprene and is harder, more brittle, and less elastic than natural rubber. The crystalline phase has two forms, the alpha phase and the beta phase. The alpha form is the material that comes from the natural tree product. The processed, or beta, form is used in gutta-percha for root fillings.
When heated. gutta-percha undergoes phase transitions. The transition from beta phase to alpha phase occurs at around 46° C. An amorphous phase develops at around 54° C to 600 C. When cooled very slowly gutta-percha crystallizes to the alpha phase.
Normal cooling returns the gutta-percha to the beta phase. Gutta- percha cones soften at a temperature above 64° C.
These cones can easily be dissolved in many solvents as chloroform, halothane and xylene. Modern gutta-percha cones that are used for root canal fillings contain only about 20% gutta-percha. The major component is zinc oxide (60% to 75%). The remaining 5% to 10% consists of various resins, waxes, and metal sulfate.

Antiseptic gutta-percha with various antimicrobial agents as chlorhexidine and calcium hydroxide may be seen. Gutta-percha cannot be heat sterilized, therefore NaOCl can be used to disinfect the cones by dipping them for 1 minute.
Pressure applied during root canal filling procedures does not compress gutta-percha, but rather compacts the gutta-percha cones to obtain a more three- dimensionally complete fill of the root canal system. After heating, while cooling, there is a slight shrinkage of approximately 1% to 2% when the gutta-percha has solidified.
Gutta-percha cannot be used alone as a filling material; it lacks the adherent properties necessary to seal the root canal space. Therefore, a sealer is always needed for the final seal. Gutta-percha cones are available in tapers matching the larger tapered rotary instruments (#.02, #.04, and #.06).

Advantages of gutta-percha
1- Inert
2- Dimensional stability
3- Non allergic
4- Antibacterial
5- Non staining to dentin
6- Radiopaque
7- Compactable
8- Softened by heat
9- Softened by organic solvents

Disadvantages of gutta-percha
1- Lack of rigidity
2- No adherence to dentin
3- No complete adaptation to narrow areas.

2- Resilon
It is a thermoplastic, synthetic, polymer-based root canal filling material. It was developed to create an adhesive bond between the solid-core material and the sealer.
Resilon can be supplied in the same ISO sizes and shapes (cones and pellets) as gutta-percha. When manufactured in cones, Resilon's flexibility is similar to that of gutta-percha. Based on polyester polymers, Resilon contains bioactive glass and radiopaque fillers (bismuth oxychloride and barium sulfate) with a filler content of approximately 65%. It can be softened with

heat or dissolved with solvents such as chloroform.

Solid type materials for obturation of the root canal

1- Semi rigid materials as silver cones which are not used now. They are flexible and fill narrow curved root canals. When silver cones contact tissue fluids or saliva, they corrode. The corrosion products are cytotoxic.

2- Rigid materials as Vitalium cones which are inflexible and were used as endodontic implants.

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ENDODONTIC 2023-2024

lec.9 / 5th stage L. AYAD MAHMOOD

# Obturation of the root canal system

Objectives of canal obturation:-
1- Prevention of percolation of periapical exudates into the root canal space.
2- Prevention of reinfection of the root canal during transient bacteremia.
3- Creation of a favorable biological environment for the process of tissue healing.

Criteria for root canal obturation
1- Asymptomatic tooth.
2- Dry canal
3- No sinus tract
4- No foul odor
5- Negative culture

## Heat softened gutta-percha techniques

### Warm lateral condensation

This technique depends on a heated spreader to soften the gutta-percha during lateral condensation to improve the adaptation of the gutta-percha to the wall of the root canal.

Technique
1- Heating the spreader is done by hot glass beads which is then inserted in the root canal.
2- Lateral condensation is done to create space for the accessory cones.
3- This procedure is repeated until the canal is completely filled.
4- An electrically heated spreader may be used.

### Warm vertical gutta-percha filling technique

It is a method of filling the radicular space in three dimensions. The canal should be with a continuously tapering funnel and keeping the apical foramen as small as possible. The armamentarium includes a variety of pluggers and a heat source.

Technique:

I- The master cone should fit short of the corrected working length (0.5 to 2 mm) with resistance to displacement. This ensures that the cone diameter is larger than the prepared canal.

2- After the adaptation of the master cone it is removed and sealer is applied in the root canal.

3- The cone is placed in the canal and a heated spreader or plugger is used to remove portion of the coronal gutta-percha and soften the remaining material in the canal.

4- A plugger is inserted into the canal and the gutta-percha is compacted, forcing the plasticized material apically.

5- The process is repeated until the apical portion has been filled.

6- The coronal canal space is back filled, using small pieces of gutta-percha.

The sectional method consists of placing 3-4 mm sections of gutta-percha approximating the size of the canal into the root, applying heat, and compacting the mass with a pluggcr.

## Thermoplastic Injection Techniques

Heating of gutta-percha outside the tooth and injecting the material into the canal is an additional variation of the thermoplastic technique. This technique is used to obturate irregularities difficult to fill by other techniques as internal resorption. The obtura Ill, Calamus, Ultradent and Guttaflow devices and systems are examples of this type.

Technique:

1- Canal preparation is similar to other obturation techniques and the apical foramen should be as small as possible to prevent extrusion of gutta-percha.

2- The canal walls are coated with sealer using the master apical file.

3- A gutta-percha pellet is preheated in the gun, and the needle is positioned in the canal so that it reaches within 3 to 5 mm of the apical preparation.

4- Gutta-percha is then gradually, passively injected by squeezing the trigger of the “gun.”

5- The needle backs out of the canal as the apical portion is filled.

6- Pluggers dipped in alcohol are used to compact the gutta-percha. Compaction should continue until the gutta-percha cools and solidifies to compensate for the contraction that takes place on cooling.

7- Both overextension and under extension are common results.

## Continues Wave Compaction Technique

It is a variation of warm vertical compaction. The manufacturing of cones to resemble the tapered preparation using rotary instrumentation permits the application of greater hydraulic force during compaction when appropriately tapered plugger are used.

Technique

1- After selecting an appropriate master cone, a plugger is prefitted to fit within 5 to 7 mm of the canal length.
2- The heat source (ex. System B unit) is set to $200^0$C.
3- The plugger is inserted into the canal orifice when the master cone is present in the root canal and activated to remove excess coronal material.
4- Compaction is initiated by placing the cold plugger against the gutta-percha in the canal orifice.
5- Firm pressure is applied and heat is activated with the device. The plugger is moved rapidly (I to 2 s) to within 3 mm of the binding point.
6- The heat is inactivated while firm pressure is maintained on the plugger for 5 to 10 seconds.
7- After the gutta-percha mass has cooled a 1 second application of heat separates the plugger from the gutta-percha, and it is removed.
8- Followed by series of compaction.
9- The remaining of the canal filled same as the thermoplastic injection techniques

## Carrier-Based Gutta-Percha

Thermafil and Soft Core cones were introduced as a gutta-percha obturation material with a solid core. The technique has a central plastic core which facilitates the adaptation of the α-phase gutta-percha to the root canal walls apically and laterally.

Advantages included ease of placement and the pliable properties of the gutta-percha.

Technique:

1- Size verifiers should fit passively at the corrected working length.
2- After drying the canal a light coat of sealer (Grossman sealer) is applied and a carrier is marked, set to the predetermined working length.
3- Removal of the smear layer is strongly recommended because it enhances the seal.
4- The carrier is disinfected with 5.25% NaOCI for 1 minute and rinsed in 70% alcohol.
5- The carrier is then placed in the heating device to the specified temperature.

6- When the carrier is heated, it has approximately 10 seconds to be inserted it into the canal. This is accomplished without rotation or twisting.
7- The position of the carrier is verified radiographically.
8- The gutta-percha is allowed 2 to 4 minutes to cool A before resecting the coronal portion of the carrier.
9- Vertical compaction of the coronal gutta-percha can be accomplished.
10- An advantage to this technique is the potential for movement of gutta-percha into lateral and accessory canals but extrusion of material beyond the apical extent of the preparation is a disadvantage.

Solvent Techniques

Gutta-percha can be plasticized with solvents such as chloroform, eucalyptol, and xylol. A gutta-percha cone is softened and placed into the canal to adapt better to the root canal wall; the mass hardens as the solvent evaporates. Disadvantages of this technique include:
1- Shrinkage occurs with the evaporation process causing voids.
2- Irritation of periradicular tissues by the solvent.

Pastes

Pastes have same requirements of the root canal obturating materials. They can adapt to the complex internal canal anatomy; however, the flow characteristic can result in extrusion or incomplete obturation. Some pastes are toxic because they include paraformaldehyde therefore they are not used now.

# Apical third filling[2, 3]

The rational behind root canal obturation has inclined toward mechanical rather than biological treatment.

It has been recognized for decades that the ideal end results of root canal therapy would be the closure of apical and all lateral foramina with reparative cementum. This permits re-establishment of a complete attachment apparatus and precludes future failure caused by pulpo-periodontal fluid exchange and retro invasion of bacteria.

The apical barrier must be biocompatible with tissues and ideally, should stimulate closure or sealing of the root canal at its most apical extent.

The barrier should also have a good sealing ability and must provide a resistant wall against which filling materials can be compacted or condensed. Clinically, the intentionally placed apical barrier is designed to prevent the overextension toxic material into the periradicular tissues and to separate these toxic materials from contact with vital tissue.

Dentin chips apical:

As the quest for more biologically compatible materials continues, the interest in using dentin fillings placed as an interface between the periapical tissue and the endodontic filling material is continued. Dentinal plugs inadvertently formed, even when clinician was trying to avoid forming them, seemed to create an effective apical barrier against which healing could occur. Probably, some of the so-called "miraculous cures" occur periradicularly, to the prepared but unfilled canals, because the apical foramina have actually been obturated by dentin chips from the preparation.

After the canal is totally debrided and shaped, a Gates-Glidden drill or Hedstrom file is used to produce dentin powder in the central position of the canal. These dentin chips may then be pushed apically with the butt end and then the blunted tip of a paper point. They are finally packed into place at the apex using a pre-measured plugger or file one size larger than the last apical enlarging instrument. One to two millimeters of chips should block the apical foramen. Completeness of density is tested by resistance to perforation by a No. 15 or 20 file. Finally, the gutta-percha is then compacted against the plug. Care should be taken during plug production not to perforate or weaken the canal wall.

Calcium hydroxide:

Calcium hydroxide Ca(OH)2 was first introduced by Hermann in 1930 as a pulp-capping agent. He demonstrated the ability of the pulp to build a dentinal bridge adjacent to calcium hydroxide as an apparent healing

process. Today calcium hydroxide occupied a prominent position as a versatile medicament for use in endodontics.

Calcium hydroxide has been used in endodontics as a root canal filling material or as a sealant in conjunction with the solid core material.

The pure calcium hydroxide powder can be used with normal saline, methylcellulose, intracanal medicament or local anesthetic solutions. The pH of all these mixtures has been found to be similar to a range of 12.3-12.5. The exact mechanism of action of calcium hydroxide is unknown. Several factors have been suggested to be responsible for the action of calcium hydroxide. The hydroxyl group is considered the most important component as it provides an alkaline environment, which is antibacterial and induces superficial necrosis of adjacent tissue. This necrotic tissue seems to be the template upon which a calcified barrier is formed. The alkalinity of calcium hydroxide has also been suggested as promoting hard tissue formation by stimulation of enzymes such as alkaline phosphatase and inhibition of osteoclastic acid phosphatase.

Calcium hydroxide can be placed as an apical plug in either dry or moist state. Dry calcium hydroxide powder may be deposited in the coronal orifice from a sterilized amalgam carrier or endodontic messing gun. The bolus may then be forced apically with a pre-measured plugger and tapped to place with the last size apical file that was used.


Moist Calcium hydroxide can be placed in a number of ways: with amalgam carrier and plugger, with a lentulo spiral, or by injection from one of the commercial syringes loaded with calcium hydroxide like calacept.

Kerr and Madison reported that the placement of calcium hydroxide powder with messing gun had several advantages:

- Greater control in the placement of the powder, thereby minimizing undesirable overfills.
- Greater powder density in the canal thereby minimizing voids.
- Greater ease in preparation

- Greater ease in placement in a short period of time.

# MTA: a new endodontic material

Introduction:

Mineral trioxide aggregate (MTA) is a material recently developed by Dr. Mahmoud Torabinejad at Loma Linda University School of Dentistry. MTA (contain trace amounts of SiO2, CaO, MgO, K2SO4, and Na2SO4) is FDA approved and is commercially available as ProRoot MTA (Tulsa Dental Products, Tulsa, OK). The material has undergone extensive research for its sealing ability and biocompatibility. MTA can be used for vital pulp therapy, an apical barrier in teeth with open apices, repair of root perforation, root-end filing, coronal barrier prior to internal bleaching, and possibly other applications.

Composition and characteristics:

MTA is a powder composed of several mineral trioxides with bismuth oxide as the main radio-opaque. Hydration of MTA leads to a colloidal gel, which cures in approximately four hours. MTA has an initial pH of 10.2 that rises to 12.5 three hours after mixing. Its compressive strength is similar to that of super EBA(Super EBA is a reinforced zinc oxide cement based on a mixture of 32% eugenol and 68% ethoxy benzoic acid (EBA)) and IRM (IRM is zinc oxide-eugenol cement reinforced by addition of 20% polymethacrylate by weight to the powder) but it is more radio-opaque.

Biological and physical properties:

The ideal root filling and perforation repair material should provide a tight seal to prevent penetration of microorganisms and their byproducts into the periradicular tissue. The same properties are desirable for a pulp capping

material to allow pulpal healing. Dyes, bacteria and their byproducts have been used to test the sealing ability of MTA. As a perforation repair material, MTA has been shown to have superior resistance to microleakage compared to IRM and amalgam. When used as a root-end filling material, studies showed that MTA provided a significantly better seal than IRM, amalgam, or super EBA.

Moisture contamination is always a concern when restorative materials are used for repair of root perforations or defects. In 1994, Torabinejad et al. conducted an in-vitro dye study of currently used root-end filling materials. They found that MTA sealed significantly better than Super EBA, IRM, or amalgam with or without blood contamination.

In-vivo and in-vitro tests have shown that MTA is biocompatible. When assessed for cytotoxicity in cell culture tests, MTA was found to be the least toxic in one cell-culture test and slightly more toxic than fresh amalgam in another cell-culture technique. In vitro tests in guinea pigs, dogs, and monkeys have convincingly demonstrated that dentin forms against MTA in vital pulp applications and cementum forms adjacent to MTA when the material is placed in root perforations and in root-end preparations.

Preparation and mixing:

MTA is mixed with water in a 3:1 powder/water ratio to use. The consistency of the mix can easily be altered by either adding a little extra moisture or by wicking it away. Mixing is accomplished on either wax paper or glass slab using plastic or metal spatulas. During its placement, proper moisture and hemorrhage control is essential. In wet conditions, MTA can become too soft and unmanageable. It is hydrophilic and requires the presence of moisture to set. In cases of perforation or other intra-canal use, a moist cotton pellet, for a minimum of four hours, provides the needed moisture. When used as a root-end filling, interstitial tissue fluid from the periradicular tissues serves the same purpose.

Clinical applications

Vital pulp therapy:

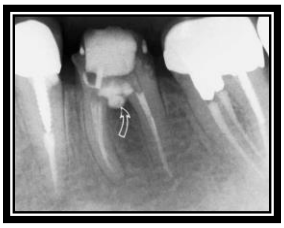
MTA can be used for vital pulp therapy in patients with traumatic crown fractures exposing vital pulp tissue, and in children with carious exposure of pulps in teeth with incompletely formed roots. In traumatic crown fractures, a shallow (partial) pulpotomy is performed in which MTA is placed directly against the pulp wound. In children with carious pulp exposure, usually in molars with incompletely formed roots, the coronal pulp tissue is removed, allowing placement of MTA against the pulp tissue at the floor of the pulp chamber. For the purpose of curing the MTA, moist cotton is placed against the material and covered with a temporary restoration. At a subsequent appointment, a definitive restoration can be placed directly against the cured MTA.

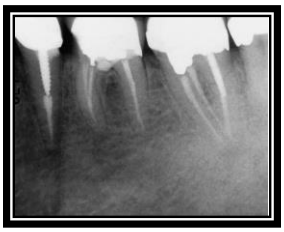
Apical barrier

To obdurate a root canal properly, an apical barrier is indicated in a tooth with an open apex. The root canal is cleaned, shaped and disinfected prior to MTA placement. A 3-4 mm plug of MTA is placed and packed into the apical root canal, and checked radiographically. If short, the material can be condensed further apically to a more desirable position. After placement of MTA, the material must not be rinsed, as this will result in a washout. When the MTA is set, the remainder of the root canal can be filled using a sealer and gutta-percha or filled with composite bonded resin to strengthen the root canal walls in teeth with poorly developed roots. Healing of the periradicular tissues should be monitored periodically.

Perforations

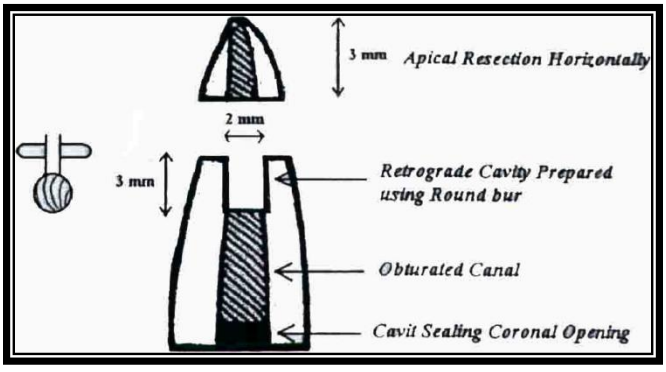
For perforation, MTA is placed such that it seals the unwanted opening to the PDL space. For apical perforation, an MTA plug is placed as described in roots with open apices. After the MTA sets, the canal space coronal to the MTA is filled using the sealer and gutta percha. In coronal canal perforations, cleaning and shaping of the apical canal space should be completed first, followed by obturation apical to the perforation site. Subsequently, the perforation site can be repaired with MTA. In cases where the apical portion of the canal cannot be obturated with gutta-percha and sealer, the entire canal can be filled with MTA. Again, the permanent restoration is placed during a subsequent visit when the MTA has fully set.





Root end filling

When used as a root-end filling material, MTA is placed into the root end cavity preparation and the excess is removed with a small piece of moist gauze. Hemorrhage is then induced to fill the bony cavity surrounding the root apex, and the flap closed. A variation to this procedure may be followed: After completion of root-end filling procedures, the surgical wound should not be irrigated because unset MTA can be able washed out of the root-end cavity preparation. To prevent such washout and still be able to irrigate the wound, MTA can be temporarily covered with Zylactin (Zila Pharmaceuticals,



Phoenix, AZ) and following irrigation, the Zylactin can be removed with a cotton pellet saturated with 100% alcohol. The soft tissue is then repositioned and sutured. Periodic monitoring of the outcome is indicated as with all surgical procedures.

## Limitations

Because MTA's compressive strength is similar to that of IRM or super EBA, it is not recommended as a permanent restorative material. When used for root end fillings, it is essential to keep the field of operation dry. If the area is too wet, the material becomes very soft and unmanageable.

Set MTA shows no signs of solubility in water; it is, however, readily recorded in an acidic environment. As acids can be generated by foods, beverages, and bacteria, MTA's exposure to the oral environment is contraindicated. Because of its gray color, surrounding dentin may appear dark; therefore, its use should be carefully considered in esthetic areas.

There are several treatment options for a necrotic or infected immature permanent tooth. Traditionally, the apexification procedure has been recommended for treating an immature tooth with an open apex.

Apexification is a procedure that promotes the formation of an apical barrier to prevent the extrusion of filling materials. The most critical drawback is the reduction in root strength due to the use of calcium hydroxide, and this increases the possibility of root fracture. Another drawback is the long time span of the entire treatment.

## Regenerative endodontic treatment

Regenerative endodontic treatment is a treatment procedure designed to replace damaged pulp tissue with viable tissue which restores the normal function of the pulp-dentin structure. After regenerative endodontic treatment, continued root development and hard tissue deposition on the dentinal wall can occur under ideal circumstances.

Regenerative endodontic treatment has the advantages of further root development and reinforcement of dentinal walls by deposition of hard tissue, thus strengthening the root against fracture.

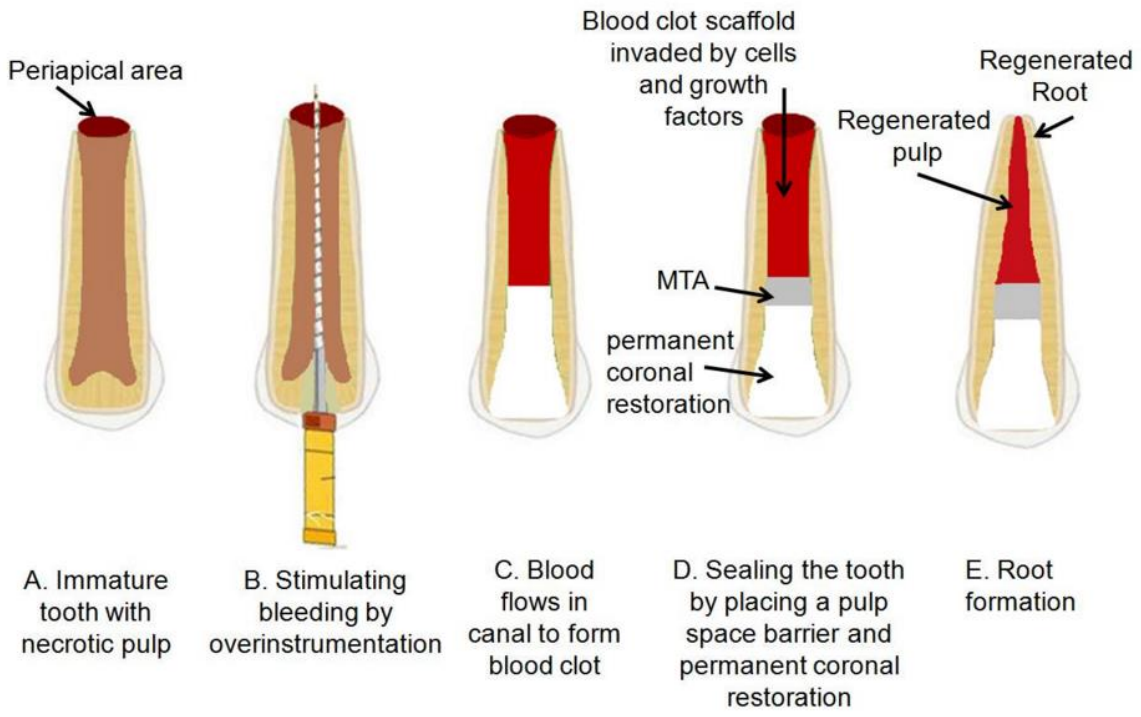
Current regimen of regenerative endodontic treatment procedures by American Association of Endodontics (AAE)

The tooth is anesthetized and isolated with a rubber dam for creating an access opening. Copious, gentle irrigation with 20 mL sodium hypochlorite (NaOCl) using an irrigation system that minimizes the possibility of extrusion of irrigants into the periapical space and lower concentrations of NaOCl are advised to minimize cytotoxicity to stem cells in the apical tissues.

The root canal is then dried with sterile paper points, and the antimicrobial medicament is applied into the canal space. A triple antibiotic paste is applied to disinfect the canal space. The triple antibiotic paste has the advantage of being a very effective antibiotic combination against intracanal microorganisms. On the other hand, calcium hydroxide has the advantage of being widely available, but it may be cytotoxic to stem cells.

At the second appointment, the patient is evaluated for resolution of signs or symptoms of an acute infection. If there are no symptoms or signs of infection, it is appropriate to proceed with the next step of the regenerative endodontic treatment.

The tooth is irrigated with 20 mL of ethylenediaminetetraacetic acid, followed by normal saline, and the antimicrobial medicament is carefully removed. After drying the canal with a paper point, a file is placed a few millimeters beyond the apical foramen and bleeding is induced up to 3 mm from the cemento-enamel junction (CEJ). To position the mineral trioxide aggregate (MTA),




Colla-Plug, which serves as a resorbable matrix, is placed into the canal. Then about 3 mm of MTA is placed, followed by placement of the final restoration. A 12 to 18-month recall is probably the minimal time to judge radiographic evidence of root development and to conduct the clinical examination.

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Lecture ١٠ د اياد محمود عبد اللطيف

# Microbiology in Endodontic

In 1894, miller's hypothesis stated that bacteria are the causative agent of apical periodontitis. Although there are other reasons such as chemical and physical irritation to the pulp can affect the pulp. This results in various degrees of inflammation.
More than 400 different microbial species have been found in infected root canals, usually in combinations. Fungi have been occasionally founding endodontic infections

## Microbial ecology and the root canal ecosystem

Change in the composition of the microbiota is due to change in environmental conditions, particularly regarding oxygen tension and nutrient availability.
In the very initial phases of the pulpal infectious process, facultative (aerobic) bacteria predominate. After a few days or weeks, oxygen decrease within the root canal as a result of pulp necrosis and consumption by facultative bacteria. Oxygen supply is affected with loss of blood circulation in the necrotic pulp which develops an obligate (unaerobic) microbiota. So we can see RC bact. Develop from aerobic to anaerobic when advanced to the deep areas.

### Root canal microbes

The most prevalent named bacterial species detected in primary infections belong to diverse genera of
1- Gram-negative bacteria: Fusobacterium, Dialister, Porphyromonas, Prevotella, Tannerella, Treponema, Campylobacter and Veillonella
2- Gram-positive bacteria: Parvimonas, Filifactor, Pseudoramibacter, Olsenefla, Actinomyces, Peptostreptococcus, Streptococcus, Propionibacterium, and Eubacterium bacteria.

## Nutrition of Bacteria

The main sources of nutrients for bacteria colonizing the root canal system include:
(1) Necrotic pulp tissue.

(2) Proteins and glycoproteins from tissue fluids and exudate that seep into the root canal system via apical and lateral foramens.
(3) Components of saliva that penetrate coronally into the root canal.
(4) Products of the metabolism of other bacteria
Organic nutrition reaches to MO from all direction

## Pulpal pathway

Bacteria, usually from dental caries, is the main source of injury to the pulpal and periradicular tissues and they enter either directly or through dentine tubules.
Modes of entry for bacteria to the pulp are as follows:
1 - Through the carrions cavity. of course this is The main route to enter bacteria
2- Through the dentinal tubules as in contamination during cavity preparation, through exposed root surface, and surfaces with erosion, abrasion and attrition. Bacteria gain access to the pulp when the dentin distance between the border of carious lesion and the pulp is 0.2 mm. many study enhance use antiseptic ( like sepsis CHX ) after cavity preparation.
3- Through the apical foramen as in advanced periodontitis where microorganisms reach the apical foramen and then the pulp.
4- Through the blood stream (anachoresis). Following trauma or inflammation to the pulp any bacteria in the blood might be attracted to the pulp causing pulpitis. It has been claimed that microorganisms can reach the pulp by anachoresis. Theoretically, microorganisms can be transported in the blood or lymph to an area of tissue damage, where they leave the vessel, enter the damaged tissue, and establish an infection
5- Through faulty tooth restoration. Studies have proven that salivary contamination from the occlusal aspect can reach the periapical area in less than 6 weeks in canals obturated with gutta-percha and sealer. If the temporary seal is broken or if the tooth structure fractures before final restoration, or if the final restoration is inadequate, bacteria may gain access to the periapical tissue and result in infection. many study insist on retreatment RCT if the postendodontic restoration lost and GP and sealer contaminated for 3 weeks.
6- Through extension of a periapical infection from adjacent infected tooth.

## Host-parasite interaction

This interaction depends on:
1- Microbial virulence factors
These are microbial products, structural components, or strategies (biofilm

formation) in the microorganism that gives it the capability to cause tissue damage. The ability of a microorganism to cause disease is regarded as pathogenicity. Virulence indicates the degree of pathogenicity of a microorganism. Some microorganisms cause disease in a host and are called primary pathogens while other microorganisms causes disease only when host defenses are decreased which are called opportunistic pathogens. Microbial products as endotoxins, endotoxin enzymes, and metabolic end products affect the microbial virulence.

2- Host resistance factors

The reaction of the host to the presence of bacteria or their products can be effective such as:

a) Platelet factors. Platelets normally circulate in the blood but also play an important role in inflammation. They are small cytoplasmic fragments derived from the megakaryocyte. Platelets are essential for blood clotting, hemostasis, and fibrinolysis. Platelets produce vasoactive amines (PAF, serotonin), chemokines, and growth factors (PGDF, FGF, TGF) during inflammation.

b) Serum factors as antibodies (IgG, 1gM)

c) Leukocytic factors as lysozymes which hydrolyzes bacterial cell wall of Gram +ve bacteria.

d) Macrophages factors.

e) Lymphocytic factors as lymphotoxin and macrophage activating factor.

f) Salivary factors as lysozyme, antibodies (IgA)

## Biofilm and Bacterial Interactions

The community-forming ability is essential for microbial survival in all environments. Most of the microorganisms in nature grow and function as members of metabolically integrated communities called the biofilms. Bioflim can be defined as a multicellular microbial community embedded by cells that are firmly attached to a surface and enmeshed in a self-produced matrix of extracellular polymeric substance, usually polysaccharide. The ability to form biofilms is regarded as a virulence factor and biofilm infections account for an estimated 65% to 80% of bacterial infections. Biofilms are structurally and dynamically organized complex biologic systems. Bacterial cells in biofilms form microcolonies (±15% by volume) that are embedded and nonrandomly distributed in the extracellular polymeric matrix (±85% by volume) and separated by water channels. The matrix is not only important physically as part of the scaffold that determines the biofilm structure, but it is also biologically active and can

retain nutrients, water, and essential enzymes within the biofilm. The matrix can also protect the biofilm community from external danger and may participate in adherence to the surface. Whereas bacteria present as planktonic cells in the main root canal may be easily accessed and eliminated by instruments and substances used during endodontic treatment, those organized in biofilms attached to the canal walls or located into isthmuses, lateral canals, and dentinal tubules are definitely more difficult to reach and may require special therapeutic strategies to be eradicated.

## Spread of bacteria in the body

1- Bacteremia

Bacteria especially alpha hemolytic streptococci can enter the bloodstream during routine dental treatment. In normal person the bacteria are killed within 10 minutes by the body defense mechanism. Infective endocarditis happens in bacteremia to patients with a history of rheumatic fever with cardiac murmur or mitral valve prolapse. .

2- Septicemia

It is a serious life-threatening bacterial (and their products) invasion of the bloodstream. It happens when body defense is low or when the infection overwhelming. It is associated with severe signs and symptoms.

3- Cellulitis

It is an acute infection of the alveolar and loose connective tissue and it is a diffused spread of infection. Clinically in endodontic cellulitis is called flare-up and it happens during access opening because of the environmental change of oxygen level in the root canal which enhances the action of the facultative bacteria and during instrumentation and obturation when debris or obturation material extrude the apical foramen.

| | cellulitis | abscess |
|---|---|---|
| Duration | Acute | Chronic |
| Pain | Severe and generalized | Localized |
| Size | Large | Small |
| Localization | Diffuse borders | Well circumscribed |
| Palpation | Doughy to indurated | Fluctuant |
| Presence of pus | No | Yes |
| Degree of seriousness | Greater | Less |
| Bacteria | Aerobic | Anaerobic |

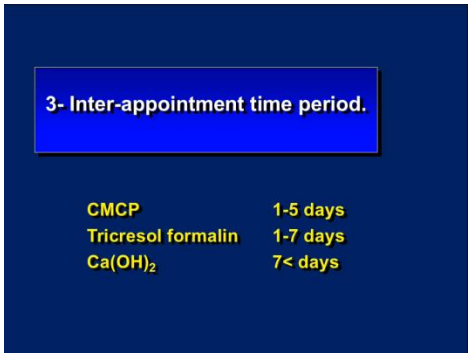
## Bacterial culturing in endodontics

There are three reasons for culturing root canal contents:

1- To determine the bacteriologic status of the root canal.
2- To assess the efficiency of the debridement procedure.
3- To isolate microbial flora for antibiotic sensitivity and resistance profiles in cases of persistent infections.

## Intracanal medicaments

The main use of an intracanal medicament is to help destroy microbes.
1- Phenol. It is an effective medicament in root canal.
2- Camphorated phenol. It is phenol liquefied in camphor. It is less toxic of the phenolic compounds.
3- Camphorated monochlorophenol (CMCP). It is more toxic than phenol but it is also more active antiseptic but does not last for more than 3 days. It is less irritating than tricresol formalin.
4- Tricresol formalin. The compound is a mixture of three isomers. It has a powerful antibacterial action that last for up to 7 days.
5- Calcium hydroxide. This is biocompatible and can be used to disinfect the root canal for more than one week. The antimicrobial activity of calcium hydroxide is related to of (OH-) in an aqueous environment. Hydroxyl ions(OH-) are highly oxidant free radicals that show extreme reactivity, reacting with several biomolecules
6- Photoactivated disinfection (PAD)
Is a medical treatment that utilizes light to activate a photosensitizing agent (photosensitizer) in the presence of oxygen. The exposure of the photosensitizer (PS) to light results in the formation of oxygen species, such as singlet oxygen and free radicals, causing localized photo damage and cell death.




## Mechanism:

PAD involves three components: light, a photosensitizer, and oxygen. APS is administered to the root canal. Upon irradiation with light of a specific wavelength, PS undergoes a transition from a low-energy ground state to an

excited singlet state. Then the PS may decay back to its ground state, with emission of fluorescence, or may undergo a transition to a higher-energy triplet state. The triplet state can react with endogenous oxygen to produce singlet oxygen and other radical species, causing a rapid and selective destruction of the target tissue.

## Antibiotics in endodontics

Antibiotics are used when infection spreads to the alveolar bone with swelling of the area above the accused tooth and drainage does not relieve the swelling.

Most of the bacterial species involved with endodontic infections are susceptible to penicillins, which make them first-line drugs of choice. In more serious cases, including life-threatening conditions, combining amoxicillin with clavulanic acid or metronidazole can achieve optimum antimicrobial effects as a result of the extended spectrum of action to include penicillin-resistant strains. Erythromycin is used in cases of penicillin allergy.

As a conclusion unnecessary use of antibiotics increases the risk for developing resistant species of bacteria.

# Tooth Discoloration and Bleaching

L. ayad mahmood 2022-2023

Tooth discoloration is defined as “any change in the hue, colour, or translucency of a tooth due to any cause; restorative filling materials, drugs (both topical and systemic), pulpal necrosis, or hemorrhage may be responsible”. The discoloration may be induced by intrinsic stains incorporated in tooth structures and extrinsic stains deposited on tooth surfaces.

Bleaching is a procedure which involves lightening of the colour of a tooth through the application of a chemical agent to oxidize the organic pigmentation in the tooth.

## Classification of discoloration

### Patient related discoloration

a. Pulp necrosis:

is one of the most common causes. The longer the pulp has been necrotic, the more intense is the discoloration. Necrotic tissue contains various protein degradation products which may penetrate the dentinal tubules and create a greyish brown discoloration of the crown. This responds well to intracoronal bleaching (non-vital bleaching technique).

b. Intrapulpal hemorrhage:

Trauma can cause hemorrhage as blood vessels rupture in the pulp chamber. Blood is hydraulically driven into the dentinal tubules, where the RBC undergoes hemolysis liberating hemoglobin. Hemoglobin is degraded releasing iron that forms a black compound by combining with hydrogen supplied to become iron supplied. Immediately after injury, crown remains pink as blood breaks down. The tooth becomes orange, then blue, then brown or black. Treatment is by intracoronal bleaching (non-vital bleaching technique).

c. Dentine hypercalcification:

Due to trauma, the pulp may form dentine rapidly to decrease the

volume of the pulp. Such new dentine increases the yellow appearance of the tooth.
Treatment starts with extracoronal bleaching (vital bleaching technique), and in case the discolouration problem was not resolved, more aggressive treatment is needed as root canal therapy followed by either intracoronal bleaching or tooth covering with veneer or crown.
d. Age:
In old aged teeth, certain problems occur to the tooth such as physiological dentine apposition, thinning and cracking of enamel and incisal wear of the tooth. Advantage in older patient's pulp recession makes aging a boon in terms of extracoronal bleaching, since; it makes the patient less sensitive to bleaching.

Tooth related Causes
a) Developmental defects
Discolorations may also result from development defects or from substances incorporated into enamel or dentin during tooth formation.
. Enamel hypocalcification: is common, appearing as a distinct brownish or whitish area, often on the facial aspect of a crown. The enamel is well formed and intact on the surface and feels hard to the explorer. Both the whitish and the brownish spots are amenable to extracoronal bleaching.
. Enamel hypoplasia: The enamel surface is defective and porous. It may be hereditary as amelogenesis imperfecta or due to environmental factors may involve only one or several teeth. Presumably during tooth formation, the matrix is altered and does not mineralize properly. The porous enamel readily acquires stains from the oral cavity. Treatment can start by extracoronal bleaching and later conservative treatment to repair the porous surface.
b) Systemic conditions
Erythroblastosis fetalis: It happens due to Rh incompatibility of blood in new born babies. Large amounts of hemosiderin pigment (an iron-storage complex) are released and discolour the dentine.

Stain is usually green, brown or blue.
. Sickle cell anaemia: It is an inherited blood dyscrasia, which cause intrinsic bluish, brown, or green discolorations. The discoloration is similar to erythroblastosis fetalis but more severe.
. Amelogenesis imperfecta: It causes yellow to brown discoloration.
. Dentinogenesis imperfecta: It causes brown, yellow or grey discoloration.
These conditions are not amenable to bleaching and should be corrected by restorative procedures such as composite build-up or crowns.

Drug related discoloration
There are certain drugs that cause tooth discolouration when ingested during its formation.
a) Tetracycline
Discoloration of this type occurs after tetracycline ingestion' usually in children.
Discoloration is bilateral, affecting multiple teeth in both arches.
Colour change ranges from light yellow to darker grey to brown depending on the dosage, duration of intake and age of the patient at time of administration of the drug.
Tetracycline binds to calcium and gets incorporated to hydroxyapatite crystals of enamel and dentine. Treatment may be achieved by extracoronal alone or intracoronal bleaching following intentional root canal therapy.
b) Endemic fluorosis
Intake of large amount of fluoride during tooth formation may produce defect in enamel matrix causing hypoplasia. It is seen as white spots ranging from chalky while to brown discoloration.
Treatment is done by extrucoronal bleaching with restorative therapy of the porous surface.
c) Chlorhcxidinc
This is a surface stain after prolonged use of chlorhcxidinc mouthwash. It ranges from yellowish to brown colour. Treatment

is achieved by extracoronal bleaching.

Dentist related discolouration

a) Discoloration related to endodontic

Pulp tissue remnants: If some pulp tissue remains in the pulp chamber especially the pulp horn, discoloration occurs due to tissue and blood decomposition. .

intracanal medicaments: Excessive use of phenolic or iodoform based medicaments may create brown, yellow or orange stains in the dentine.

Obturating materials: gutta-percha has to be removed from the pulp chamber to prevent tooth discoloration. Root canal sealers containing silver may cause black stains.

The above mentioned causes of discolouration are considered intrinsic because it affects inner structure of the tooth, and they respond well to non-vital bleaching technique.

b) Discoloration related to Restoration

> Amalgam: Silver alloys have long been condemned for staining dentin a dark grey.

> Pins and posts: Metal pins and posts may show through the composite restoration or cause blue greyish stains of the composite filling.

> Composite: Microleakage around a composite filling may discolour the tooth due to the entrance of bacteria and fluids through the gap between the tooth and the filling.

Treatment of the abovementioned causes is replacement of the filling.

## Bleaching Materials

Bleaching compounds may act as either oxidizing or reducing agents. Commonly used agents arc solutions of hydrogen peroxide' sodium perborate, and carbamide peroxide. Both sodium perborate and carbamide peroxide release hydrogen peroxide after their

gradual degradation. Hydrogen peroxide and carbamide peroxide are mainly indicated for extracoronal bleaching, whereas sodium perborate is mostly used for intracoronal bleaching.
Hydrogen peroxide: is a powerful oxidizer that is available in different Concentration. Superoxyl and Perhydrol of 30% to 35% concentrations respectively are the most common used solutions. Although hydrogen peroxide will bleach quickly, it should be handled with care as it has a caustic and burns effects on soft tissue in Contact.
Sodium perborate: It is available in powder form, which is stable when dry, but in the presence of water, acid, and worm air it decomposes to form sodium metaborate, hydrogen peroxide and oxygen. It is safe and easily controlled so it is used in intracoronal bleaching.
Carbamide peroxide: It is also called urea hydrogen peroxide (3 - 3 5%). Popular agent contains 10% carbamide peroxide, which breaks down into urea, ammonia' carbon dioxide, and approximately 3.5% hydrogen peroxide.

## Mechanism of bleaching action

Mechanism of bleaching is mainly linked to degradation of high molecular weight complex organic molecules (stain) that reflect a specific wavelength of light that is responsible for colour of stain. The resulting degradation products are of lower molecular weight and composed of less complex molecules that reflect less light, resulting in a reduction or elimination of discoloration. Bleaching agents act on the organic structure of the dental hard tissues, slowly degrading them to by-products as carbon dioxide. Inorganic molecules do not react with the bleaching agents.
Bleaching action is also called oxidation-reduction reaction or redox reaction which is formed by cleavage of either an O-H bond or the O-O bond in hydrogen peroxide to give H + 00H and 20H (hydroxyl radical), that oxide or reduces other organic molecules.

## Extracoronal (vital) bleaching techniques

+ In-office bleaching

. Pumice the teeth to clean off any debris present on the tooth surface.
. Isolate the teeth with rubber dam.
. Saturate the cotton or gauze piece with bleaching solution (30-35% H202) and place it on the teeth.
. lises heat and light to activate bleaching material (Curing Light, Plasma Arc Light, laser).
. Change solution in between after every 4 to 5 minutes.
. Remove solution with the help of wet gauge.
. Repeat the procedure until desired shade is produced.
. Remove solution and irrigate teeth thoroughly with warm water.
. Polish teeth and apply neutral sodium fluoride gel.
. Instruct the patient to avoid coffee, tea, etc. for 2 weeks.
. Second and third appointment is given after 3-6 weeks.

+ Mouthguard bleaching

. Mouthguard bleaching may be carried out in the dentist's office and at home by the patient. The product most often used is carbamide peroxide, and the percentage of peroxide ranges from 10 to 35%.
. Take the impression and make a stone model.
. Apply separating media on the cast model.
. Material used for fabrication of bleaching tray is flexible plastie. Most common tray material used is ethyl vinyl acetate.
. Cast the plastic in vacuum tray forming machines.
. Trim and polish the tray.
. Checking the tray for correct fit, retention and overextension.
. Demonstrate the amount of bleaching material to be placed.
. If the product is being used in the office, the 35% carbamide peroxide gel is applied to the tooth indentations in the guard, which is then inserted into the patient's mouth for 30 minutes at a time. When used at home, the 10% gel is used and the guard may be in place 3 or 4 hours at a time, with the gel replaced every 2 hours.

Many patients wear the guard all night.
. Treatment should take from 4 to 24 weeks, depending on the severity of the staining.

Intracoronal (nonvital) bleaching techniques for endodontically treated teeth The protocols commonly used to bleach root canal treated teeth are the thermocatalytic and walking bleach techniques.
+ Thermocatalytic technique
This technique involves placing the bleaching agent in the pulp chamber and then applying heat, which supplied by heat lamps, flamed, instruments or electrical heating devices.
. Isolate the tooth with rubber dam.
. Prepare an access opening and remove any gutta-percha or filling material from the pulp chamber.
. Place bleaching agent (H202 or sodium perborate or both) in the tooth chamber.
. Heat the agent with heat by a heat source (heat lamps, flamed, instruments, electrical heating devices, hot stick or light source).
. Repeat the steps until bleaching gives satisfactory results.
. Wash the pulp chamber with water, and then seal the tooth with cotton pellet and temporary material.
. After 2-3 weeks, recall the patient to analyses the bleaching results.
. Place suitable filling material to seal the tooth cavity permanently.

. Walking bleaching technique.
. This technique is the safest and requires the least chair time.
. Isolate the tooth with rubber dam.
. The restorative material is removed from the access cavity, and any gutta-percha or filling material should be removed from the pulp chamber.
. Sufficient layer (2 mm thickness) of protective cement barrier (polycarboxylate, zinc phosphate, glass ionomer) is applied on the

obturating material. This is essential to minimize leakage of bleaching agents.
. Place a freshly mixed sodium perborate/water mixture in the pulp chamber.
. Place a temporary filling to seal the access opening.
. Recall the patient after 1-2 weeks and repeat the treatment when needed.
. After completion of bleaching, close the access opening with composite material.
In case the discoloration is internal and external, a combination treatment can be done by:
a) Intracoronal bleaching and in-office bleaching (placing H202 on the facial surface and placing a heat source)
b) Intracoronal bleaching and home bleaching using a night guard template and H202 gel.

## Effect of bleaching agents on the tooth and surrounding structures

1. Tooth sensitivity
This is mostly seen with in office technique! H202 with heat. This may be due to penetration of the bleaching agent into enamel and dentine and junctions with restorations.
2. Effect on enamel
Bleaching agents decrease enamel hardness but fluoride application restores remineralization of enamel.
3. Effect on pulp
When the bleaching agent penetrates the enamel and dentine it will cause transient reduction in pulpal blood flow.
4. Cervical resorption
When using H202 of more than 30% concentration, external cervical resorption may occur.
5. Effect on composite

After bleaching, composite fillings may be affected by surface roughening of the restoration. Tensile strength is decreased and microleakage is more possible to occur.

# Endodontic Emergency Treatment

L. AYAD MAHMOOD **2023-2024**

Emergency conditions in endodontic induce infection, which is expressed as pain and/or swelling. Any irritation to the tissues results in inflammation and the release of chemical mediators which with pressure induce pain. Chemical mediators cause pain by lowering the pain threshold of the sensory nerve fibers or by increasing vascular permeability and producing edema. Increased fluid pressure resulting from edema directly stimulates the am receptors.

## The classification of endodontic emergencies includes:

A- Pretreatment

1- Dentin hypersensitivity
2- Pain of pulpal origin
a) Reversible pulpitis
b) Irreversible pulpitis
3- Acute apical periodontitis
4- Acute apical abscess
5- Traumatic injury
6- Cracked tooth syndrome

B- Patients under treatment

1- Mid treatment flare-up.
2- Exposure of pulp
3- Fracture of tooth
4- Recently placed restoration
5- Periodontal treatment

C- Post endodontic treatment

1- Overinstrurnentation
2- Overextended obturation
3- Underfihling
4- Fracture of root
5- High restoration

## Irreversible acute pulpitis

The diagnosis of irreversible pulpitis can be subcategorized as:
1 - Asymptomatic. Asymptomatic irreversible pulpitis means a tooth that has no symptoms, hut with deep caries or tooth structure loss that, if left

untreated, will cause the tooth to become symptomatic or non-vital.

2- Symptomatic. Pain from symptomatic irreversible pulpitis is often an emergency condition that requires immediate treatment. These teeth exhibit intermittent or spontaneous pain, whereby exposure to extreme temperatures, espcial1y cold, will elicit intense and prolonged episodes of pain, even after the source of the stimulus is removed.
Teeth with irreversible pulpitis with definite periapical inflammatory extension, an occlusal reduction is recommended. Antibiotics are not recommended for the emergency management of irreversible pulpitis.

## Steps of treatment

a) Clean the root canal(s) to the working length.
b) Place a suitable medicament in the pulp canal and chamber (ex. Calcium hydroxide).
c) Close the access opening with a temporary filling.
d) Check occlusion of the tooth.
e) Prescribe a pain analgesic.

## Acute apical periodontitis

It is inflammation of the apical periodontal tissue caused by extension of pulpal infection periapically. It is characterized by the following features:
1- Elevated tooth from its socket because of buildup in fluid pressure in the periodontal ligament.
2- Discomfort on biting.
3- Sensitivity to percussion.

### Steps of management

1- Access opening preparation.
2- Total pulp extirpation.
3- Cleaning the root canal.
4- Thorough irrigation and dryness.
5- Placement of intracanal medicament as Calcium hydroxide.
6- Close the tooth with a temporary filling material.
7- Relieve occlusion.
8- Prescribe analgesics.

## Acute periapical abscess

Extrusion of bacteria from the root canal to the periapical area induces infection ending in the formation of a collection of pus. An acute periapical

abscess is characterized by the following features:
1- Clinically a swelling is evident with pain and a sensation of tooth elevation.
2- Radiographic evidence varies in the size of the lesion.
3- Systemic fever.

Steps of management
1- Pulp debridement of its contents.
2- Incision and drainage (if swelling is present)
3- If pus is oozing the tooth may be left open for 1 day for drainage.
4- Antibiotics may be prescribed only if systemic features are present as fever.
5- Relieve the tooth out of occlusion.
6- Analgesics should be prescribed.

A local anesthetic is contraindicated to be used because:
1- Pain caused by injection in the distended area.
2- Chance of the spread of microorganisms.
3- Ineffectiveness of local anesthetics.

## Cracked tooth syndrome

It means an incomplete fracture of a tooth with vital pulp. It is commonly seen with teeth with large restorations. Pain is experienced when the patient chews laterally a cotton roll.

Steps of treatment
1- Immediately reduce the occlusal contact with the cracked area.
2- Analyze the extent of the crack to preserve pulpal health.
3- If the pulp is involved and the crack is superficial to the alveolar bone endodontic treatment is necessary.
4- If the crack is below the alveolar bone extraction of the tooth is necessary.

## Intratreatment flare-up

Flare-up is the occurrence of pain, swelling, or both during root canal treatment.

Risk factors contributing to flare-ups:
1 Overinstrumentation and overobturation.
2-Inadequate debridement.
3- Periapical extrusion of debris.

4- Preoperative pain, percussion sensitivity, and swelling.
5- One visit endodontics in cases of acute apical periodontitis.
6- Retreatment.
7- Apprehension.
8- History of allergies.

Steps of management
1- Reassurance of the patient
2- Complete debridement of the root canal with no overinstrumentation or extrusion of debris.
3- Establishment of drainage if pus is present.
4- Relief of occlusion
5- Calcium hydroxide intracanal medication.
6- Analgesic and antibiotic prescription.

## Overextended treatment beyond the apex.

Any extension of an instrument or filling material induces acute inflammation and the presence of extruded debris will cause infection. Pain is magnified because of the limited area between the bone and the tooth.

Steps of treatment
1- Care should be taken into consideration not to extend instrumentation beyond the apex.
2- Reinstruinentation to the exact working length should be done to ensure an apical stop area to prevent the extrusion of gutta-percha.
3- If gutta-percha is extended beyond the apex then retreatment should be performed by special retreatment kits as ProTaper retreament and D-Race systems.
4- Analgesic should be prescribed.

## Fracture of tooth

During treatment or after it the tooth may be subjected to force and it might fracture. The treatment depends on the extent of the fractured area (in a crown or including root). The steps of treatment resemble that of the cracked tooth syndrome.