

# ***Crown and ridge Prosthodontics***

**Dr. Sahar Abdul Razzaq**

## ***Lecture.1***

### **Prosthodontics**

The dental specialty was concerned with the making of artificial replacements for missing parts of the mouth and jaw. Also prosthetic dentistry or prosthodontics.

**Partial dentures**: Are divided into two types: fixed partial dentures and removable partial dentures.

**Crown**: It's a cemented extra coronal restoration that covers, or veneers, the outer surface of the clinical crown.

It must restore the morphology, contour and function of the tooth and should protect the remaining structures from further damage.

### **Fixed Prosthodontics (Crown and Bridge Prosthodontics):**

It's a branch of dental science that deals with the restoration of damaged teeth with artificial crown and replacing the missing natural teeth by a dental prosthesis permanently cemented in place [Fixed partial denture].

### **Fixed Prosthodontics involves:**

- Inlays-gold and all- ceramic.                       Gold crowns-full and partial veneer.
- Porcelain & Zirconium-all porcelain and PFM.     Fixed partial dentures.

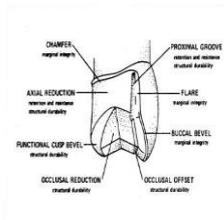
### **Types of crowns: (classification)**

#### **A) According to the coverage area**

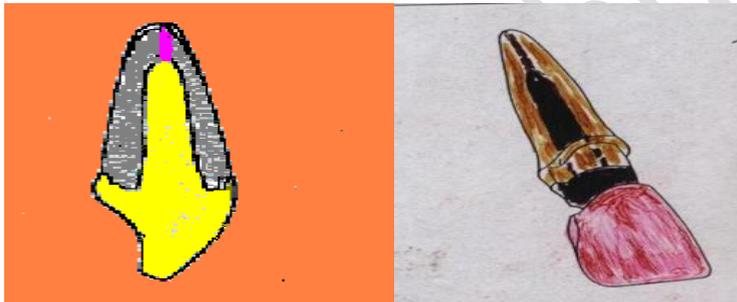
1. **Complete crown**: Complete crown: it is the crown that covers all the coronal portion of the tooth such as a full metal crown, all Ceramic crowns which is a complete crown made of ceramic material.



**2. Partial Crown:** It is a crown that covers part of the coronal portion of the tooth such as 3/4 Crown, 7/8 crown.



**3. Complete replacement:** It involves those which replace the natural crown completely. This type of crown keeps itself by means of a metal extended inside the root canal space of the tooth such as a post crown.



**B) According to Materials:** According to Materials used in the construction of crown and bridge, crown restorations could be made of:

- 1. Metal Crowns** {Gold alloy and its alternatives} as in Full metal Crown and 3/4 Crown.
- 2. Nonmetal crowns:** Such as Acrylic resin, Zirconium or Porcelain as in jacket crown.
- 3. A combination:** of metal and plastic materials as in PFM crown restorations.

**Bridge:** It is a fixed dental prosthesis (appliance) which that replaces and restores the function and esthetic of one or more missing natural teeth; it cannot be removed from the mouth by the patient. It is firstly supported by natural teeth

or roots. A **tooth that** gives support to the bridge or part of the bridge to which retainer is cemented **an abutment tooth**.

**Components of the bridge:**

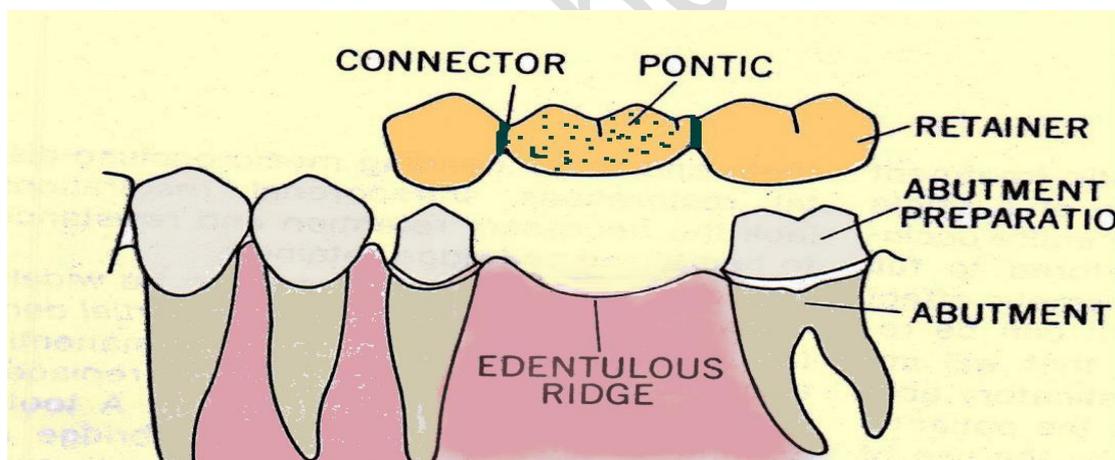
**1. Retainer:** It's the part that covers the abutment tooth, which could be major or minor.

((When the retainer is attaching to fixed connector it's a major, but when it is attached to removable connector it's called minor connector.

**2. Pontic:** It's the part of the bridge that replaces the missing teeth, which is the suspended part of the bridge and is made from gold, alloys, porcelain or a combination of these materials: It occupies the position of missing natural tooth or teeth.

**3. Connector:** It is the part that connects the retainer to the Pontic, which could be a fixed or removable connector.

**4. Abutment:** It's the part of the bridge to which the retainer is cemented.



***There are four main types of dental bridges:***

**1. Fixed-fixed bridge:** Most common used anteriorly and posteriorly. The pontics are connected rigidly to the retainers at both ends of the bridge by the solder joint, so we have only one path of insertion.

**2. Fixed-movable bridge:** The Pontic is attached to a fixed retainer on one side while the another side is a movable joint that connected with other retainer.

**3. Cantilever bridge:**

- a. Simple: consist of one or two retainers with the Pontic that replaces the missing tooth.
- b. Spring: the Pontic is connected to a gold bar that also connected to the retainer which is away from the Pontic. usually used in case of missing maxillary central or lateral on one side of the maxillary arch with the presence of distance between the anterior teeth.

**4. Resin –bonded bridge. (Maryland)**

There is minimal preparation within the enamel, used for short span (3-units), less retentive than other types and use composite or resin for cementation to the abutment tooth.

***Materials of crown and bridge:***

- 1. Metal material: in full metal crown
- 2. Plastic material: such as acrylic resin or porcelain
- 3. A combination: metal and plastic material as in full veneer crown.

***Advantages of fixed bridge***

- 1. Replacing missing teeth to provide function and esthetic.
- 2. As space maintainer following extraction to prevent over eruption of opposing tooth.
- 3. To restore the fractured and badly carious tooth by retainer part of the bridge.

4. Maintain periodontal health of abutment by the retainer.
5. Restoring the psychological demand of patients (esthetic, function, phonetic).

***Contra indication of the bridge:***

1. Long span edentulous area.
2. Free end extension area.
3. Abutment teeth with unstable bone support.
4. Short inter jaw space and short teeth.
5. Excessive bone loss especially in the visible anterior teeth because the bridge will have an unacceptable appearance.
6. Patient with dry mouth (xerostomia) because of the great risk of recurrent caries.
7. Occupation and habit limitation (bruxism)
8. Financial limitation.

***Principles of tooth preparation***

***Objectives of tooth Preparation:-***

**The main objectives of tooth preparation**

- 1-To eliminate undercuts from the axial surface of the tooth.
- 2-To provide enough space for the crown restoration to withstand the force of mastication, this space depends on the material used, so the metal material needs little space while the plastic material needs more space.
- 3- Not to enlarge the size of the tooth.
- 4- To provide good esthetic.

### **Finishing line of the preparation (F. l):**

It's the final margin that separates between the prepared and the unprepared tooth structure.

### **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

### **Types (design or configuration) of the finish line:**

The following designs for the 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



# ***Crowns and bridges Prosthodontics***

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## ***Lecture.2***

### ***Impression material***

#### ***Impression material***

**Dental impression:** A dental impression is a negative imprint of hard (teeth) and soft tissues in the mouth from which a positive reproduction (cast or model) can be formed. It is made by placing an appropriate material in a stock or a custom dental impression tray which is designed to roughly fit over the dental arches.



#### **Properties of impression materials in crown and bridge:**

- 1-Accuracy it must be capable of reproducing detail and contour of the prepared surfaces of the teeth.
- 2-Dimensional stability.
- 3- Elasticity, strength and freedom distortion.

4-Flow the material must have a low viscosity so as to flow readily when

Inserted into the mouth and thus penetrate the finest crevices and reproduce the smoothest details.

5- Compatibility with die materials.

**Primary impression:** It is a negative, replace of dental arch from which study cast is fabricated; it is taken by use of a stock tray.

**From a Primary cast: (study bridge, temporary, bridge a closely adapted tray especially, made for each patient must be):**

**Final impression:** It is a negative, replace of dental arch from which master cast is fabricated; it is taken by use of a special tray.

**Special tray (or individual tray):** It is made of acrylic used for only one patient to take a final impression; it is either perforated or non-perforated according to impression material. It is made of acrylic used for only one patient to take a final impression; it is either perforated or non-perforated according to impression material. Three occlusal stoppers must be incorporated in the tray to prevent it from being forced onto prepared teeth.

### **Working cast**

It is a replica of the prepared tooth (teeth), ridge area & the other part of the dental arch. It is produced from the final impression, on which we will make the wax pattern (Lab. work) of the final restoration.

### **Working casts and dies:**

Because direct fabrication of wax patterns in the mouth is difficult. All wax patterns are made in the laboratory with the indirect technique. This technique requires an accurate reproduction of the prepared tooth, the surrounding soft tissues, and the adjacent and opposing teeth. A cast-and-die system captures the necessary information so that it can be transferred to the laboratory.



### **Requirement of the good working cast:-**

1. Must be free from the air bubbles especially at the area of the gingival finish line & the occlusal surface.
2. Must reproduce all details that have been captured by the impression.
3. Must be free from the any distortion.
4. It should be trimmed to ensure access for the carving wax pattern (at the margin).

### **Die:-**

It is the (+ve) reproduction of the model of the individual (single) prepared tooth on which we will do wax pattern (its produce from the final impression).

### **Requirement of the dies:-**

1. Must be reproduced the preparation exactly.
2. Must be free from the air bubbles.
3. Must return to its exact position on the cast when it removed.
4. Must be stable, even when the cast inverted.

### **Type of the dies materials:**

1. Gypsum dies.
  2. Resin dies.
  3. Electroplated dies.
- 1- Cheap material.

### **1-Gypsum dies:**

### **Advantages of the stone dies are**

1. Easy to be prepared.

2. Can be used with all type of impression material.
3. Cheap.
4. Need less requirements and easy to manipulate.

**The Disadvantage of this material is:**

1. Its comparatively poor resistance to and abrasion, low strength.
2. Undergo dimensional changes (expansion).

**2- Resin dies:**

**Characteristics of this type of the die:**

- 1- Most available resin die materials are epoxy resins, but polyurethane is also used.
- 2- It can be cured at room temperature without expensive or complicated equipment.
- 3- Its abrasion resistance is many times greater than that of gypsum products.
- 4- Detail reproduction is better on resin die than gypsum die.
- 5- Prostheses fabricated on resin dies will fit more tightly than those made of gypsum.

**The Disadvantage of this material is**

1. It is more expensive than gypsum.
2. It undergoes some shrinkage during polymerization.

**3- Electroplated the die:**

1. This technique involves the deposition of a coat of pure silver or copper on the impression.
2. The areas to be plated are first coated with finely powdered silver or graphite to make them conduct electricity, and the impression is then placed in an electroplating bath.
3. A layer of pure metal is deposited on the impression and is supported with type IV stone or resin.

**Note:**

The main drawback of silver plating is the use of a cyanide solution, which requires a special reservation because of its extreme toxicity.

**There are two basic working casts and die systems:**

- a. Working cast with separating die.
- b. Working cast with soled die.

**Removable Dies:**

- A. The die is a complete component of the master cast and can be lifted from the cast to facilitate access.
- b. The cast is made in two pours of type IV or V stone of contrasting colors: the first pour forms the teeth, and drilling the cast and cementing the dowel pins into the set stone are also possible.
- c. The index system is designed to facilitate this latter technique. The second pour forms the base of the cast. The area to be removed is coated with a separating agent before the second layer is poured. In other areas, undercuts are provided to prevent unwanted separation.



**Advantages:**

- 1. The wax pattern does not need to change from one cast to the other and this gives more accuracy.

2. It eliminates the discrepancy between cast and die which produce from the separate impression.

### **Solid Cast with Individual Die (separated die).**

The solid cast-and-individual die system also referred to as the *multiple pour technique*.

#### **Advantage of separated die:**

1. It is a simplest means of fabricating the working cast and die.
2. The working cast requires only minimum trimming. Since the gingival tissues around the prepared teeth are left intact, they can be used as a guide when contouring the restorations.

It keeps the attachment shape between cast & abutments fix & movable.

#### **Disadvantages of the solid cast technique include the following:**

- 1-Distortion of the wax pattern may occur during transfer it from the die to another cast.
- 2-The technique can be used only with elastomeric impression materials.
- 3-Not suitable for long span bridge because of giving more changes in the long span during work.
- 4-The accurate setting of wax pattern and the casting may be uncensored.

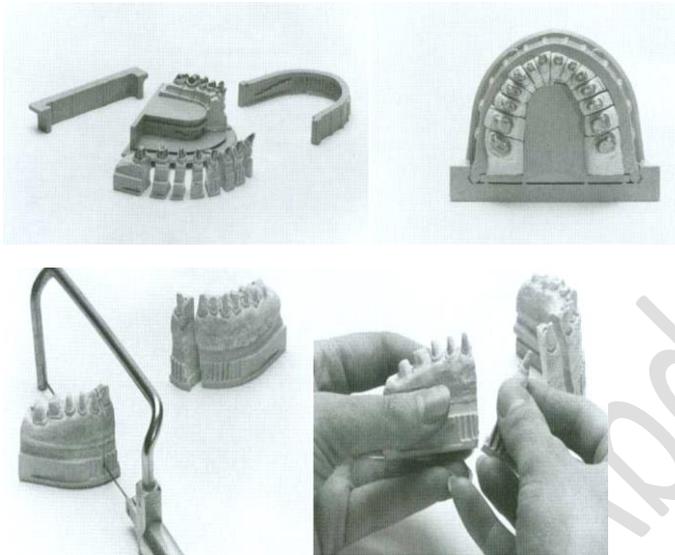
### **3- Die- lok technique:**

The Die-LOK technique uses a specially articulated tray.

1. The impression is poured and the cast trimmed into a horseshoe configuration that fits in the special tray.
2. The tray is filled with a second mix, and the cast is the seat.

3. When the stone has set, the tray is disassembled, saw cuts are made on each side of the preparation, and the resulting die is trimmed.

4. The cast and die can be **reassembled in the tray**, which is then mounted on an articulator. A **disadvantage** of this system is that the overall size of the tray can make articulation and manipulation difficult.



**There are two systems for producing cast with removable die:**

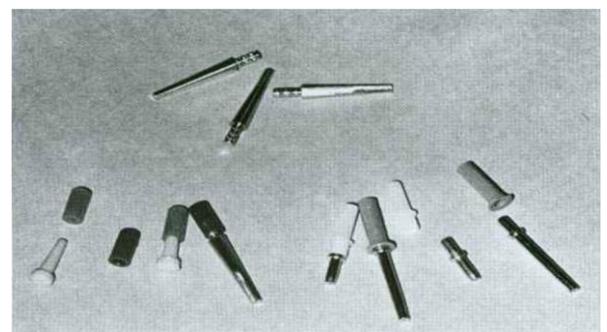
1. Dowel pin with the hair pin system.
2. A Pindex, technique.

**Type of dowel pin:**

A- Straight dowel pin:

1. Taper brass dowel pin or (half round dowel pin or Flat sided dowel pin )
2. Double straight.
- 3-Two head dowel pin

B- Curved dowel pin

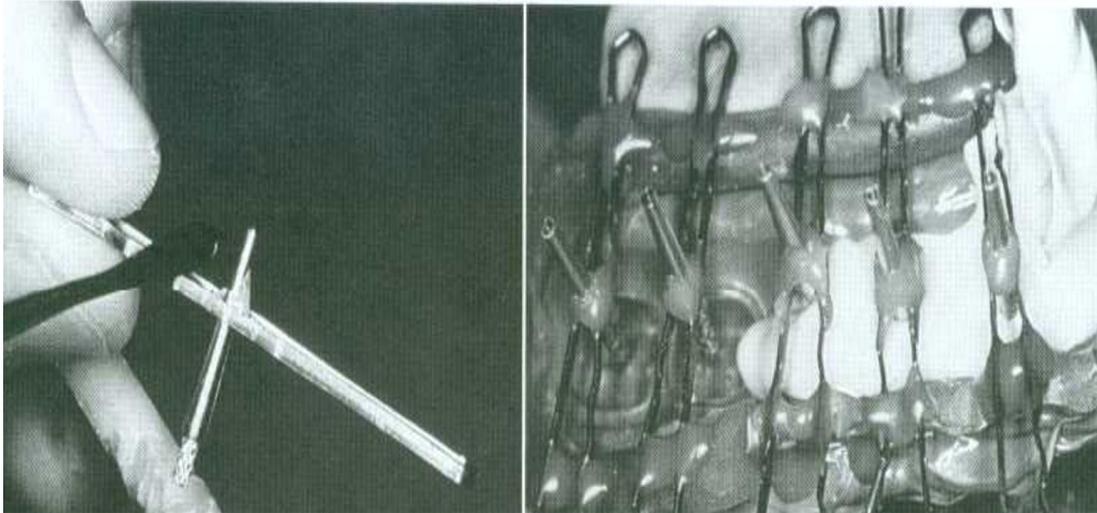


Types of dowel pin

## **1-Dowel pin with hair pin system:**

### **Procedure:**

- 1- After taking the impression, clean it from saliva and debris blood.
- 2- Inspection for the position of the prepared tooth.
- 3- Fix the dowel pin on the prepared tooth according to rule for fixation:
  - A- Vertical and parallel to the long axis of tooth.
  - B- On center prepared tooth.
  - C- 3-4mm away from the margin of the impression.
  - D- Multiple dowel pin must be parallel for insertion.
- 4- Fix the dowel pin by use hair pin and fixation by sticky wax.
- 5 -Pouring the first layer of die stone.
- 6 -Using a retention mean the area of unprepared teeth at an initial setting time.
- 7 -Remove the bobby's hair; clean the cast from the sticky wax and coated the prepared area only with a separating medium .
- 8 -Place the wax ball at the end of dowel pin.
- 9 -Do boxing give a good thickness of base (10-12mm).
- 10- Pouring the second layer, and open the cast after setting.



Positioning dowel pins before cast pouring can be accomplished with bobby's pins and sticky wax.

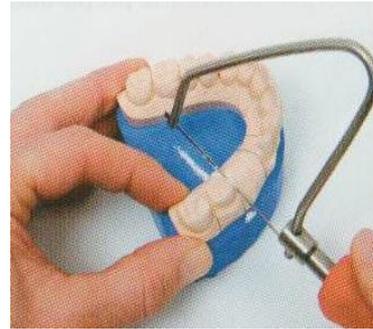
## **2-Pindex technique:**

*When the Pindex system is being used:*

1. The Pour of stone is removed from the impression once it has set.
2. The base is then ground flat in a plane that must be perpendicular to the intended position of the appendix pins.
3. The periphery of the cast is trimmed to fit in a special mold (base former). After the cast is dried, the location of the pins is marked and their holes are drilled with a special drill press.
4. The pins are cemented in place with cyanoacrylate resin; special sleeves are positioned over the cemented pins, and coated the prepared area only with a separating medium.

## **Cutting of the die;**

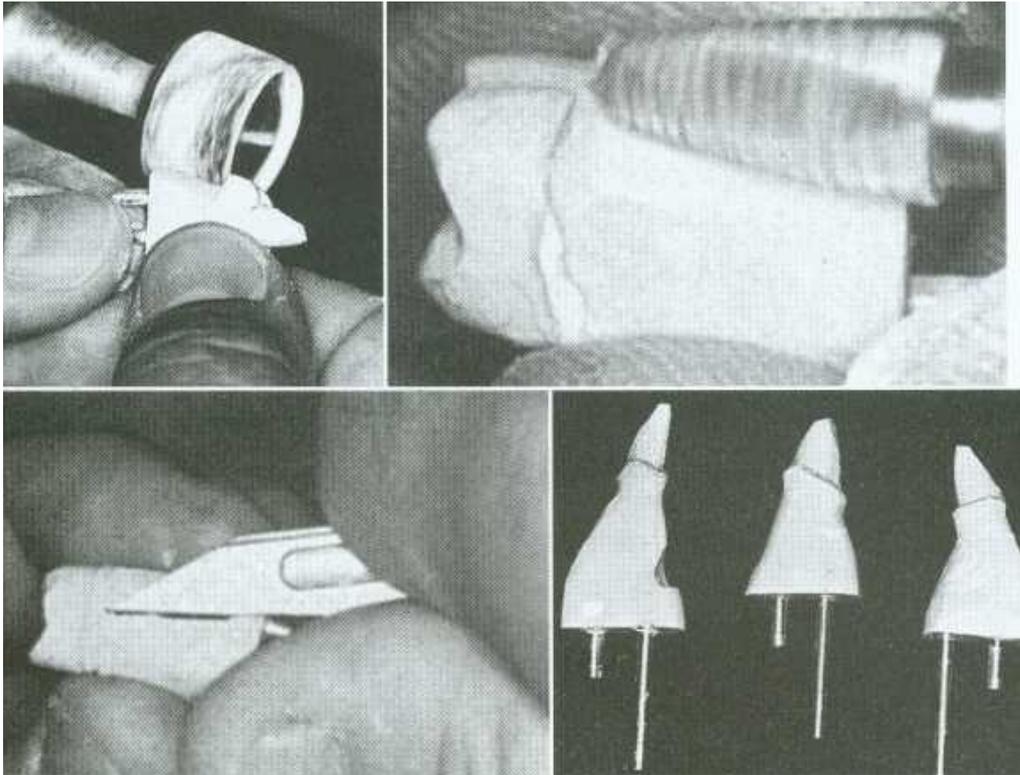
Using lead pencil carefully mark lines starting from the tooth side end of the base of the cast, these lines represented the cutting lines, after that using handsaw for cutting the die.



### **Trimming of the die:**

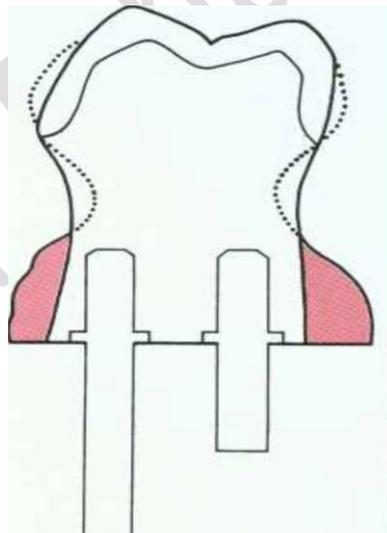
1. Cutting from the die to make the finish line clear and clean.
2. The die should be trimmed gingival of the finish line to provide edict of the finish line and burnishing, there **are two designs** for trimming either **ditching creating** a sharp undercut below the finish line which makes it **thin or more suitable to fracture** in finish line and **over bulkiness** in the wax pattern. While in **trimming** slight removal below the finish line which is approximately like natural so it gives a normal thickness of wax patterns. **How to make the trimming:**

- 1- Remove stone at 2-3mm apical to finish line, using pear shape tungsten carbide burs.
- 2- Using sharp blades number 25 for the cutting all around the finish line, and smoothing the die stone below the finish line.
- 3- Mark the finish line of bright red. Color pen this facilitate the carving of the margin of wax pattern black graphite should not be used for contamination.



**Why we do trimming to the die:**

1. To clear and clean to finish line and well localized the fit on the die.
2. To facilitate waxing procedure and make well margin securing an extension in order to produce good finishing and burnishing of wax pattern margin which create good bulkiness of axial wall.



**IMPORTANT!** When trimming a die, the original contour of the tooth structure below the margin **MUST** be preserved. Overtrimming (*dotted line*) will result in overcontoured restorations!

# ***Crowns and bridges Prosthodontics***

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## ***Lecture.3***

**Inter occlusal relationship**: Is the relationship between the maxillary and mandibular jaw that exists when teeth together.

**Occlusion**: Means the contact of teeth in opposing denture arch when jaws are closed [static occlusal relationship] and during various jaw movements [dynamic occlusal relationships].

**Centric relationship**: The relationship between maxillary and mandibular arches that exists when the condyles are in their terminal hinge axis (on the most superior posterior position) in the glenoid fossa. It is the starting point of occlusion. Centric relation is the physiologic position of the condylar head of the mandible (without stress) from which all other movement is initiated.

**Centric relation** is taken **when no enough occlusal stops** are left after teeth preparation especially in cases of full mouth rehabilitation of FPD, including **distal terminal abutments (Uni or bilaterally)** **In centric relation, it must not perforate the registration material.**

**Centric occlusion**: Teeth to teeth relationship, it is the maximum occlusal contact or interception irrespective of condylar position. Maxillary and mandibular teeth should contact in a **harmonious manner** that allows **optimum function**, minimum trauma to the supporting structure and an even distribution of load through the dentition.

**Centric occlusion can be taken when there are enough occlusal stops after preparation for a crown & bridge.**

In recording the centric occlusion with maximum interception, the recording material must show **perforation in the area of contact teeth.**

If the **centric occlusion** is **not in harmony** with **centric relation**, the interfering tooth contact requires the condyle to be pulled out of their terminal

hinge position to make the teeth fit, the final result of such disharmony between the teeth & the joint is stress, which may be manifested in **several ways problems** of T.M.J articulation, maintenance of **periodontal support** of the teeth or **excessive or premature wear of tooth surface**.

### **Methods of inter- Occlusal record techniques:**

A. If enough teeth are present in both upper and lower arches to stabilize their relationship, no bite registration is needed, we can transfer the relation by hand articulation.

B. If the remaining teeth are insufficient to provide hand articulation of the cast we can use:

**1. Pink base plate wax or Alu-wax (wax reinforced with AL fiber).**

**2 .Registration past:**

A **zinc-oxide eugenol** quick set paste is mixed and applied to a plastic bite frame with fiberglass to support B.R.P.

**3. The base plate and bite rime.**

### **Articulator :**

Is a mechanical device e that represents the T.M.J, the maxilla, the mandible, to which maxillary and mandibular casts may be attached to stimulate some or all mandibular movements. It's made from metal.

**Anterior bite stop:** This bite stop is a piece of acrylic which made by biting in a **piece of acrylic in the incisal region** which assistance in mounting the mandibular in relation to the maxilla **after** the occlusal surface of posterior teeth have been prepared for preventing over closure which made in the incisal region. The accuracy of this procedure is the primary importance because it represents the anatomic and functional of the patent.

**Preparing the cast for mounting:** In preparing casts for mounting on at articulator it is necessary to perform several initial checks.

1. Inspect the occlusal surface of the teeth in both the working and opposing the casts. Carefully remove all nodules or bubbles of stone so that there is no interference **with the tooth –to- tooth contact.**
2. If there are broken or chipped **working cusps** on the Buccal surface of the mandibular cast or lingual surface of the maxillary cast considers obtaining new cast.
3. Inspect thoroughly the surface of the teeth or the land areas of the cast for any interference with occlusion.
4. If most of the teeth are present and in good condition and on interference remains the interception will make it possible to articulate the cast by hand.
5. Trim the casts to the desired thickness in relation to the articulator.
6. Position the cast between the upper and lower member of the articulator.
7. If a face- bow is available make certain that the model will fit in the face bow without touching mounting plate.
8. Create wedge-shaped V indices in the wax occlusion rims.
9. Block out the dowel pin recesses to the pins after mounting and to prevent interference with accurate and positive seating of the dies and dowel pins in the model.

**Orienting the maxillary cast:** The indirect technique of mounting the maxillary cast will be demonstrated. However, the direct mounting technique may also be used to mount the maxillary edentulous cast.

**Casts in centric relation:**

Trim the record to include only the tips of the cusps and make it possible to observe the relationships of the record no teeth anterior to the preparation to prevent improper separation and distortion of both vertical and frontal occlusal relationships after properly relating the casts in tooth to tooth relationship with either interception by hand or unilateral record maintain the relationships by uses sticky wax directly on the teeth or by using a rubber bands or using section of wooden tongue blade and sticky wax.

# ***Crown and ridge Prosthodontics***

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***Lectur 4***

**Wax pattern**

The first procedure for the casting of an inlay or crown is the preparation of a wax pattern.

**Wax pattern:** it is the precursor of the final cast restoration were the wax placed on the prepared tooth, it should be clear, smooth, should be duplicate accurately the final anatomical feature of the original tooth & should be free from any debris.

The information needed to duplicate the anatomical feature is taken from the adjacent teeth, the opposing teeth & from the general knowledge of the dental anatomy.

**Techniques of construction of wax pattern (w. p):-**

**1. Intra oral technique (direct technique).**

In which the w.p. is constructed inside the patient mouth using type I inlay wax, mostly we use this technique in construction of the posterior inlay restoration & anterior post-crown.

**2. Extra oral technique (indirect technique).**

Here we use type II inlay wax to construct the w. p. on the die of the die of the working cast.



### **The advantage of the indirect over the direct tech.:-**

1. It reduces the chair time so it saves the dentist time & more comfortable to the patient.
2. It offer opportunity for the visualization of the restoration & readily (direct) access to waxing the margin.
3. It is probably the easiest mean of fabricating cast restoration

**Inlay wax:** The wax pattern is an accurate reproduction of the missing tooth structure. It forms the outline of the mold into which the gold alloy is cast.

### **Inlay Wax Composition:**

- a. Paraffin wax =base wax
- b. Carnauba wax =Modifier wax
- c. Ceresin = modifier wax
- d. Bees wax =modifier wax
- e. Colorants = colorant

### **Classification of inlay wax**

The American dental association [ADA] No.4 **divided inlay** casting wax.

**Type A:** a hard or low flow, wax used in the same indirect technique.

**Type B:** a medium wax [used with direct techniques].

**Type C:** a softer [generally used for the indirect fabrication of casting].

**Three Requirement** and properties of inlay wax must be controlled while in order to have accurate cast restoration.

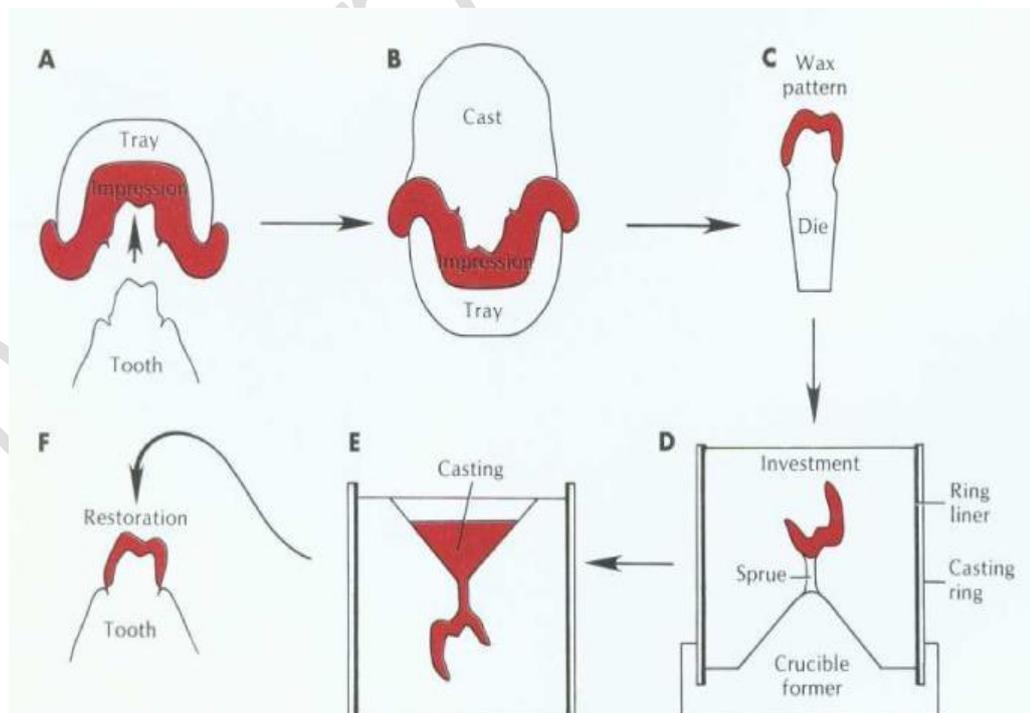
- 1- **Residual:** Since the mold must burn out cleanly for entry of molten alloy there must be no residual as the specification to allow.
- 2- **Flow or plasticity:** They must there a good flow, which sufficient to fill the area in the preparation and reproduce the required detail so the wax must be flow readily when heated without chipping or losing its smoothness and it is necessary to contour the stability of the wax once it has reached the top rather at which its carved burnished and polished.

3- **Expansion:** The inlay wax is softened with heat and all waxes expansions under heating and contract Harding in cooling when heated or cooled, but it must be rigid enough to allow good carrying without chipping or distortion.

The color of inlay wax either blue- red or green to distinguish from the color of the die.

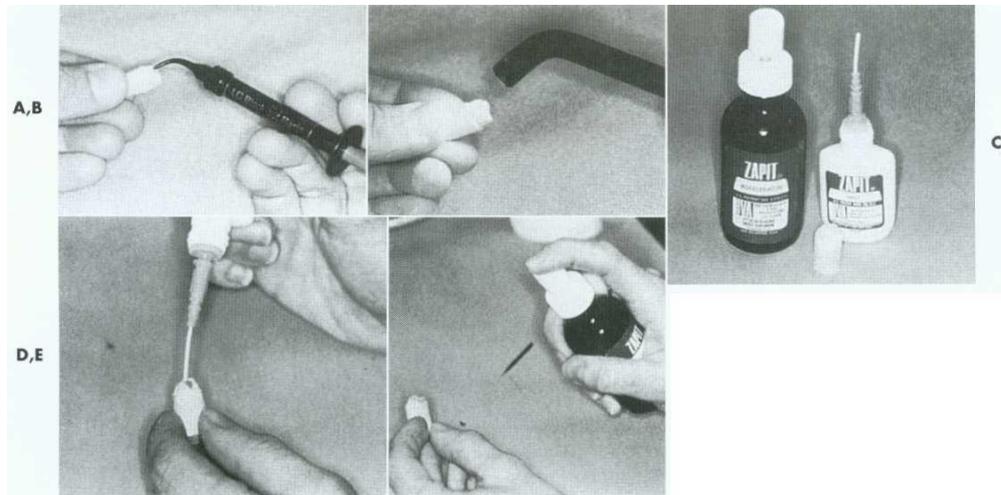
### Wax pattern of anterior teeth:

This technique consists of obtaining an accurate impression of the prepared tooth (Fig. 1, A) and making a cast from the impression (Fig. 1, B) which a wax pattern that resembles the shape of the final restoration is shaped (Fig. 1, C). A mold is then made around the wax pattern with a refractory investment material (Fig.1, D). When the investment has set, the wax is vaporized in an electric furnace. The hollow mold is then filled with molten casting alloy, reproducing every detail of the wax pattern (Fig.1, E). The metal casting is retrieved, excess metal is removed, and after polishing, the cast restoration is ready for clinical evaluation (Fig.1, F).



### **Correction of defects:**

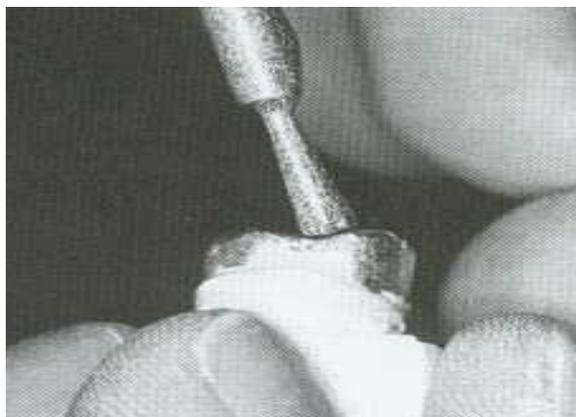
Even every small undercut on the die of a tooth preparation will result in the pattern. Zinc phosphate cement is a suitable material used for blocking out the undercut on the working cast (Fig. 2).



**Fig. 2**

### **Adding of adequate cement spacer or die spacer:**

Space should exist between the internal surface of the casting and the prepared surface of the tooth except for the finishing line. The spacer provides room for the luting agent and allows completion sealing of the restoration during cementation. The ideal dimension for the cement spacer or die spacer is 20 to 40  $\mu\text{m}$  for each wall and it should be kept at least 1mm away from margin to prevent dissolution of the luting agent (Fig. 3).



**Fig. 3**

## **Marking the finishing lines:**

By marking the finishing line with the colored pencil, the technician can pinpoint this location. The color should be contrasted with that of the wax that will be used ex. Red pencil can be used for a green wax). An ordinary lead pencil is not recommended, because it can abrade the die, its darker color can interfere with the wax properly adapted at the finishing line, and traces of the graphite (an ant reflux) can prevent the complete casting of the margin.

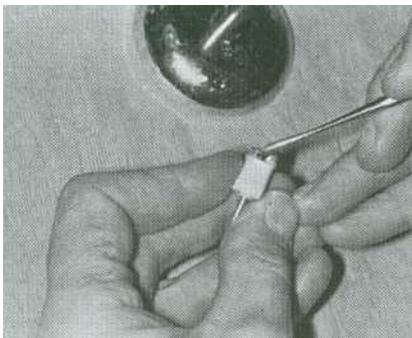
## **Waxing technique:**

### **1-Wax is adding technique:**

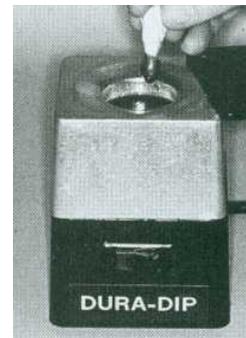
Flow the molten wax on to the die from a well-heated, large waxing instrument (Fig.4, A).

### **2-Dipping technique:**

Dipping the lubricated die in the alternative method for doing well-adapted internal surface (Fig. 4, B).



**A**



**B**

**Fig. 4**

### **3- Adapting technique:**

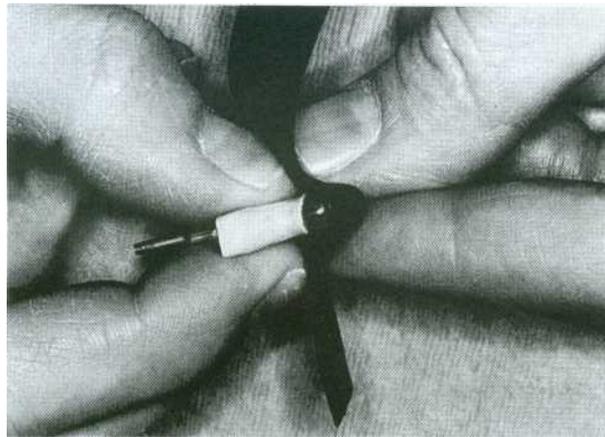
Apply a sheet of soft green casting wax (0.5mm) gauge to the die.

## **Wax pattern procedure:**

### **a- Internal surface (coping):**

1- To prevent the wax from sticking to the die stone, coat the die thoroughly with die lubricant and allow it to soak into several minutes. If the surface of the die is dry, repeat the application the lubricant and remove any excess of lubricant.

- 2- Flow wax over the surface of the die using hot wax spatula developing a uniform thin initial coping of wax on the die, to ensure that the finished restoration will have adequate proximal contact area with the adjacent teeth after casting and polishing, the best way of achieving this is to remove small amount of stone from the proximal surfaces of the teeth on the cast on either side of prepared tooth.
3. If the pattern may be excess wax gingival to the margin removal, rotate the pattern under a bright light and looks for shadows formed bolds or increases using a high-quality magnifying loupe are helpful in evaluating the pattern (Fig.5)



**Wax pattern of posterior teeth:**

***Steps in waxing procedure:***

1. Cover all the preparation in one time with molten wax to make a coping of wax this can be obtained by immersing the preparation in the dish contain molten wax , so now obtain the 1<sup>st</sup> layer of the wax pattern .
2. Add wax to the proximal surface (wall) of the restoration in relation to the adjacent teeth (to build the contact area in relation to the adjacent teeth).
3. Build the axial wall (Buccal & lingual) to the normal counter.
4. Build the occlusal surface of the restoration following (in relation ) curve of spee & curve of Wilson , then check & adjust the occlusal relation with opposing teeth in centric & eccentric relation.

5. Check again all the margins of the restoration (w.p) to ensure that the margin of the (w. p) have no over or under extension, so the wax pattern is now ready for the next step.



### **Margin finishing:**

**Lift of the pattern, replace it and check for defects:**

#### **1-Overwaxed margin:**

This may lead to **breaking** off when a pattern is **withdrawn** from the die.

#### **2-Short margin:**

The waxing does not extend to the red **finish line** will not provide an adequate seal for the final restoration.

#### **3-Ripples:**

**Any roughness in the wax near from the margin** will be **uplicated** in the casting. These **roughness's in the final restoration lead to plaque collections** that lead to **irritation and inflammation of the adjacent gingival tissue.**

#### **4-Thick margin:**

**Thick, round margin** will result in **poor sealing** of the restoration and **poor axial contours** lead to **periodontal problems**. The margin should be fabricated **with the fine edge**.

#### 4- Open margin:

It may occur during any stages of fabrication the wax pattern. The margin must be **remitted to ensure** close adaptation on the finish line.

After complete, all these procedures the wax pattern smoothing with a cotton roll dipped in die lubricant.

## ***Crown and ridge Prosthodontics***

**Dr. Sahar Abdul Razzaq**

### ***Lecture.5***

**Distortion of the wax pattern cannot be prevented, but can be minimized by:**

1. Using only waxes which guarantee to melt the A.D.A. Specification No.4. Type 1 for direct and type 2 for indirect.
2. The wax pattern should never be left off the die.
3. The wax pattern should be invested as soon as possible after lubrication.
4. Method of heating which must be uniform.
5. Adding molten wax for repair purpose or by car this must be minimized to prevent localized energy changes.
6. The flow of the solidified wax when the pattern is removed from the mouth or die.
7. Delay the investment of the pattern longer than 30minutes it will be often under 90 distortions so it must be invested immediately to avoid the distortion. Not; if delay cannot be avoided the pattern should be placed in a refrigerator, and they should be allowed to room temperature before investment and the margin should be adapted well and punished to avoid open margin the wax pattern should be left of the die .
8. Never left the wax pattern near the heat source.

### **Spruing Procedure:**

**Spruing:** Is a process of connecting the wax pattern with the crucible former in the casting ring with a pin made of wax, plastic or metal (Fig.1).

**Sprue:** It's a channel through which the molten alloy can reach the mold in an invested ring after the wax has been eliminated.

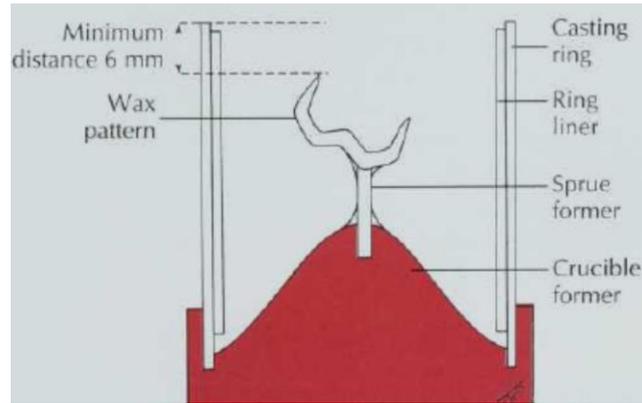


Fig. 1.

**Sprue design varies depending on (Fig. 2):**

1. The type of restoration being cast.
2. The alloy used.
3. The casting machine.

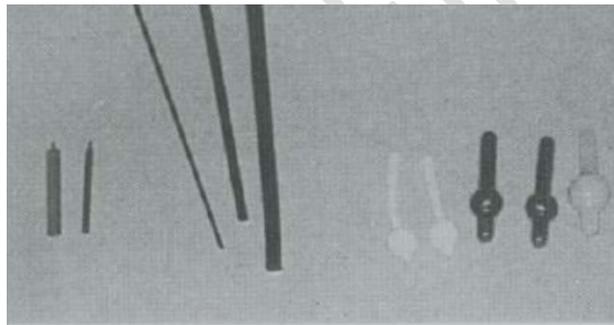


Fig. 2. Prefabricated sprues.

**Role of the sprue:**

1. The sprue must allow the molten wax to escape from the mold.
2. The sprue must enable the molten metal to flow into the mold .
- 3 .The metal within it must remain molten slightly longer than the alloy that has filled the mold.

**Purposes of the sprue:**

1. The shape of the channel in the **refractory mold** is determined by the sprue connecting the wax pattern to the crucible former.

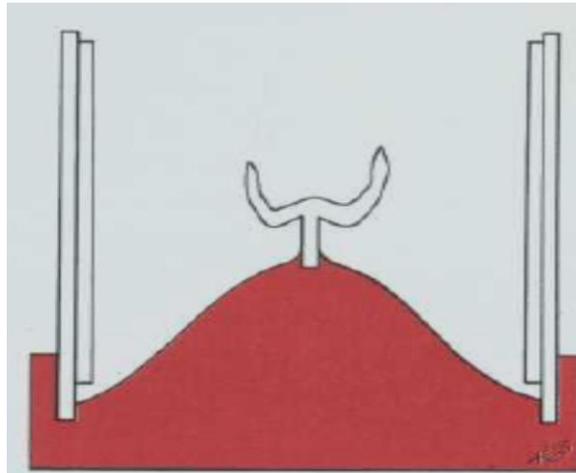
2. The sprue can be **wax, plastic, or metal**. Wax sprues are preferred for most castings because they melt at the same rate as the pattern and thus allow easy escape of the molten wax.
3. Solid plastic sprues soften at a higher temperature than the wax pattern and may block the escape of wax, resulting in increased casting roughness.
4. Also, hollow plastic sprues are available that permit the escape of wax.
5. Metal sprue is used; it should be made of **non-rusting metal** to avoid possible contamination of the wax. Metal sprues are often **hollow** to increase the contact surface area and strengthen the attachment between the sprue and pattern.
6. They are usually removed from the investment at the same time as the crucible former.
7. Special care must be taken to **examine the orifice** for small particles of investment that may break off when such a sprue is removed because these can cause an incomplete casting if undetected.

### **Requirements of sprue**

#### **Dimensions and location of the sprue**

- **Diameter**: the diameter of the sprue should be as large as possible to improve the flow the molten metal into the mold cavity and to provide a reservoir to compensate for the shrinkage of the metal during solidification.
- **Length**: the length of the sprue should be adjusted so that when we attach it to the crucible former the margin of the wax pattern should be about 6 mm away from the end of the casting ring. It is made so that the wax pattern will be in the center of the casting ring and surrounded by a uniform thickness of the investment material.
- **Location**: the attachment of the sprue with the wax pattern should be to the bulkiest area of the wax pattern and should be at an angle to allow the incoming metal to pass freely to all portions of the mold cavity without any turbulence. The attachment should be at the non-centric area.

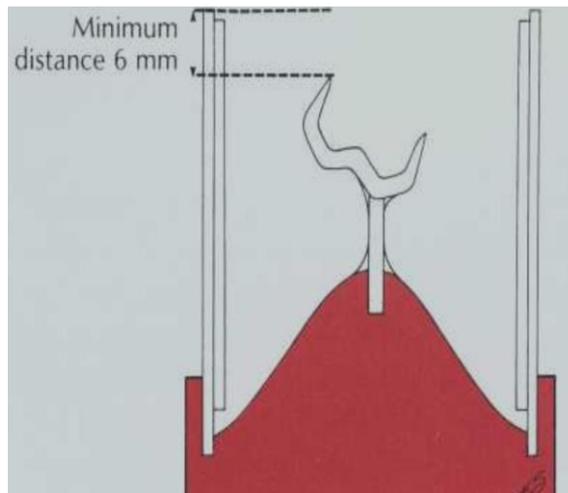
4. The sprue must also allow for proper positioning of the pattern in the ring. This can be critical because expansion within the mold is not uniform. For example, Spruing on the cusp tip can give good results, but Spruing on the proximal contact may produce a casting that is too wide mesiodistally and too short occlusal-cervically (Fig. 3).



**Fig. 3.**Incorrect sprue placement

### **Attachment of sprue:**

1. The sprues point of attachment to the pattern should be carefully smoothed to minimize turbulence.
2. The attachment area should not be restricted because necking increases casting porosity and reduce mold filling.
- 3. If the pattern is too close to the end of the ring the molten alloy may blast through the investment during casting, if it's too far, gases may not escape rapidly enough to permit complete filling of the mold with alloy.**



**Fig.4**

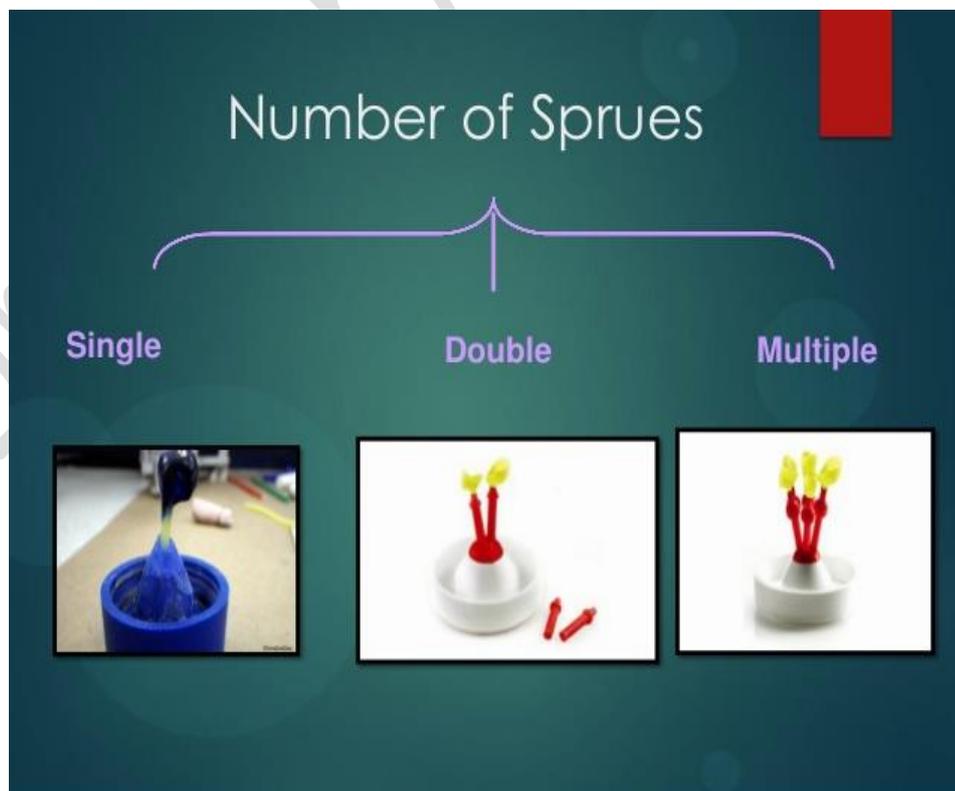
### **Venting**

Small auxiliary sprue or vents have been recommended to improve casting of thin patterns and may help in gases escape during casting.

Compensate for shrinkage during solidification.

### **Number of sprues:**

**Single, Double, Multiple**



## ***Crown and ridge Prosthodontics***

**Dr. Sahar Abdul Razzaq**

### ***Lecture 6***

#### **Investing:**

It is the surrounding of the wax pattern with a mold of heat resistant material that can accurately duplicate the shape and anatomical features of the wax pattern to obtain a mold after burning out the wax pattern.

#### **Objectives of investing:**

1. It should provide an accurate reproduction of the anatomical form of the wax pattern.
2. It should provide sufficient strength to withstand the heat of the burnout procedure and the actual casting of the molten metal.
3. It should provide compensation expansion equal to the solidification shrinkage of the metal; therefore, the mold cavity should be larger than the wax pattern (if this does not happen, the restoration will be smaller than the wax pattern).

#### **To do investing we need:**

- 1-Casting ring.
- 2-Ring liner.
- 3-Crucible former.

#### **Casting Ring:**

The casting ring is made of metal and is used to hold the investment material in place during its setting and to restrict its expansion. If we use the casting ring alone we will not have the expansion, so we need to use the ring liner to allow a certain degree of expansion.

#### **Ring Liner:**

The liner is used to line the inside of the casting ring. It is made from a

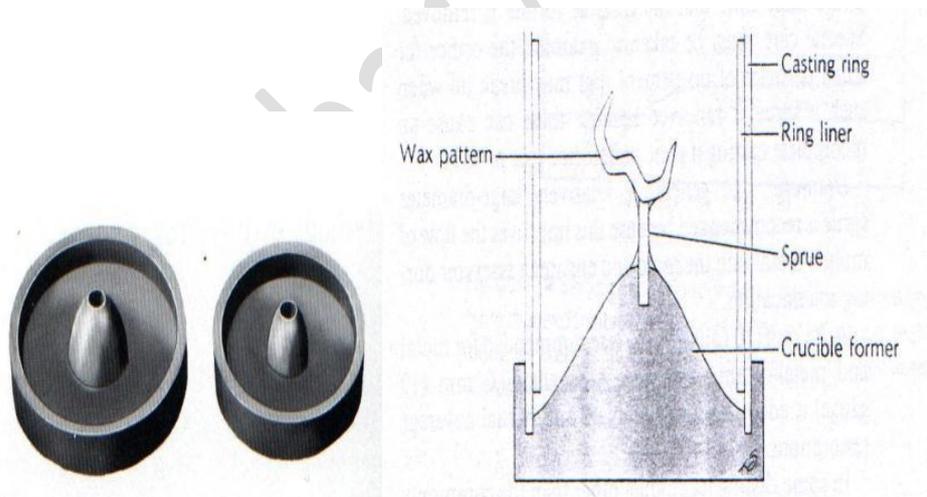
compressible material. e.g., asbestos (0.6mm thick) that allows the investment material to expand to some degree, but as it is carcinogenic other materials as fiberglass may be used. If there is no room for expansion outward the mold cavity would produce a small casting. The liner should be 3mm shorter than both ends of the casting ring because it will bind the investment to the ring to prevent the slipping of the whole mass during the casting procedure.

### **Advantages of the ring liner:**

1. It provides a room of pliable material against which the investment can expand to enlarge the mold cavity to compensate for solidification shrinkage of the metal.
2. It permits easier removal of the investment and casting from the ring after the burnout procedure.
3. It acts as an insulator against loss of heat during the casting procedure

### **Crucible Former:**

It is a cone-shape base made of rubber or metal, which forms the base of the casting ring, and to which the other end of the sprue is attached.

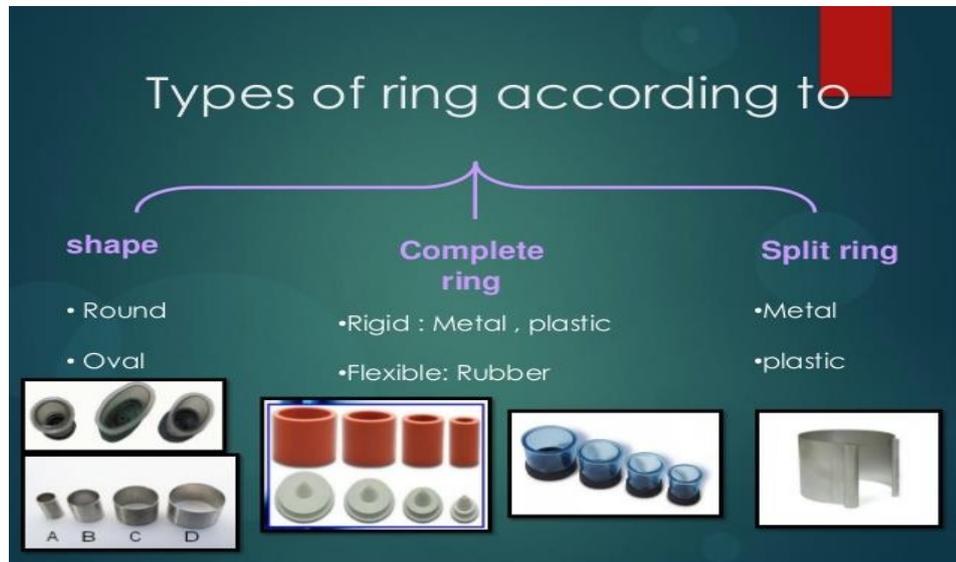


### **Purposes of using conical crucible former:**

1. To get the proper position of the wax pattern inside the casting ring.
2. To create a cone-shape way for the easy entrance of the molten metal.

### **Mold Cavity:**

It is the space created inside the investment after the burnout procedure which was occupied by the wax pattern, sprue and crucible form.



### Investment materials

**A dental investment:** Is a **refractory material** that is used to surround the wax pattern during the procedure of fabricating the metallic permanent restoration. It **forms the mold** into which the alloy is cast after the wax has been eliminated.

An investment material to be used for a casting  mold should expand on the setting and heating to compensate for the shrinkage of molten metal as it solidifies. Metal casting alloys have different melting ranges  $\frac{3}{4}$  only pure metals and alloys of eutectic composition have a melting point.

### The requirement of investment:

1. The investment material should be of a suitable consistency for adaptation to the wax model and have a reasonable the setting time.

2. To withstand the temperatures required for the casting process, there should be no distortion, no decomposition; the investment should not fragment under the impact of the molten metal.

3. The material should be porous to allow the escape of air and gases and the investment should be easily removed from the casting after cooling.

### **Classification of Dental Investment Materials:**

• **Gypsum-bonded investments:** binder is gypsum (calcium sulfate hemihydrate). Used when casting **conventional gold alloys** containing 65% to 75% gold at temperatures near 1,100°C.

• **Phosphate-bonded investments:** binder is a metallic oxide and a **phosphate**. Two types: (**Type I**) is used when casting **base metal alloys** for metal-ceramic crowns and (**Type II**) is used for removable partial denture frameworks. Are capable of withstanding high temperatures (above 1,100°C).

• **Silica-bonded investments:** binder is ethyl silicate. Not used much today.

The **refractory material** for these investments is either quartz or cristobalite. This material provides the thermal expansion for the investment. **Note:** The expansion of the investment provides a larger mold **to compensate** for the subsequent contraction of the alloy.

### **Methods of mixing the investment material:**

**1. Manual:** mixing and pouring of the investment is done by the spatula manually.

**2. Mechanical:** mixing is done by a vacuum mixer to ensure that the mix is completely free from any bubbles. Pouring the investment is done by one of the following methods:

**i. Brush technique:** the investment is applied to the wax pattern with a brush and then we fill the casting ring.

**ii. Vacuum technique:** the casting ring is attached to the vacuum mixing bowl. The bowl is inverted under vibration to fill the casting ring.

### **Vacuum mixing machine**



### **WAX ELIMINATION OR BURNOUT**

1. Wax elimination or burnout consists of heating the investment in a thermostatically controlled oven until all effects of the wax are vaporized.
2. The temperature reached by the investment determines the thermal expansion. All water in the investment must be driven off during wax elimination.
3. The temperature to which the ring is heated during wax elimination must be sufficiently high.
4. It should be maintained long enough ("heat soak") to minimize a sudden drop in temperature upon removal from the oven. Such a drop could result in an incomplete casting because of excessively rapid solidification of the alloy as it enters the mold.

5. Once the investment is heated during the wax-elimination procedure, heating must be continued, and casting must be completed. Cooling and reheating of the investment can cause casting inaccuracy because the refractory and binder will not revert to their original forms.

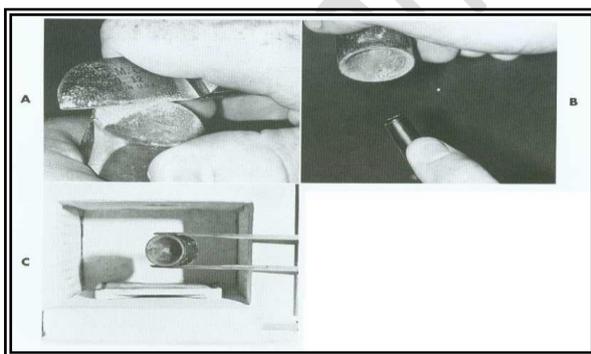
6. Inadequate expansion and cracking of the investment are typical results.

### **STEP-BY-STEP PROCEDURE**

1. Allow the investment to set for the recommended time (usually 1 hour) and then remove the rubber crucible former. If a metal sprue is used, remove it as well. The smooth skin that forms on the ring with phosphate-bonded investments should be removed, and any loose particles of investment should be blown off with compressed air.

2. Reexamine the ring for any residual particles and then place it with the sprue facing down in the furnace on a ribbed tray. The tray allows the molten wax to flow out freely.

3. Bring the furnace to 200° C (400° F) and hold this temperature for 30 minutes. Most of the wax is eliminated by this time.



**Fig. 1.** A, When the investment has set, the "skin" at the top of the ring is trimmed off. B, The rubber crucible former is removed, and any loose particles of investment are blown off. C, The ring is then placed in the furnace for the recommended burnout schedule.

4. Increase the heat to the final burnout temperature (generally 650° C [1200° F] or 480° C [900° F] if a hygroscopic technique is used; follow the manufacturer's instructions) and hold for 45 minutes. Because the heating rate affects the expansion, it also should be standardized as part of the investing and

casting protocol for the accurately fitting castings. The mold is now ready for casting, although a large casting ring usually requires increased heating time. If preferred, two burnout furnaces can be set of 200° C and 650° C or 480° C, or a programmable two-stage furnace can serve equally well. However, the investment should not be overheated or kept at the temperature too long. Gypsum-bonded investments are not stable above 650 ° C (1200° F).

Also, some carbon in carbon-containing investments burns off; causing increased surface roughness of the casting.

When transferring the casting ring to the casting machine, a quick visual check of the sprue in shaded light is helpful to see whether it is properly heated. It should be a cherry-red color.

## **Casting**

### **Casting machines;**

1. A casting machine requires a heat source to melt the alloy and a casting force. 2. For a complete casting, the casting force must be high enough to overcome the high surface tension of the molten alloy as well as the resistance of the gas within the mold.
3. The heat source can be either the reducing flame of a torch or electricity.
4. Conventional alloys can be melted with a gas-air torch (Fig. 3, A and B), but the metal-ceramic alloys in a higher melting range need a gas-oxygen torch (Fig.3, C. Base metal alloys need a multi-orifice gas-oxygen (Fig.3, D) or oxyacetylene torch. Electric heating can occur by convection from a heating muffle or by the generation of an induction current in the alloy.
5. The heating can be more evenly controlled, preventing undesirable changes in alloy composition caused by **Volatilization** of the lower melting point

elements. 6. The electric machines are expensive and more appropriate for larger dental laboratories, where as a torch may be the method of choice for smaller laboratories and dental offices.

7. Present-day casting machines still use either air pressure or centrifugal force to fill the mold, which were first proposed in the early days of lost-wax castings. Some machines evacuate the mold before it is filled with metal, and the vacuum has been shown to improve mold filling, although it is not clear if the difference is clinically significant

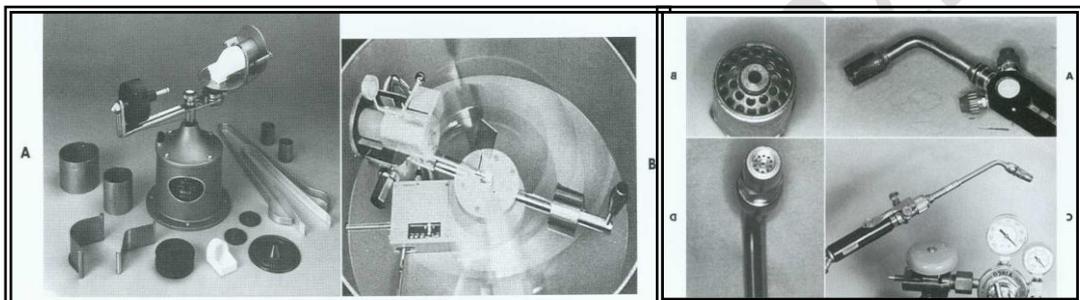


Fig. 2. Casting machines.

Fig. 3

A, Gas-air π B, Gas-air tip. C, Gas-oxygen casting torch. D, Multiorifice tip.

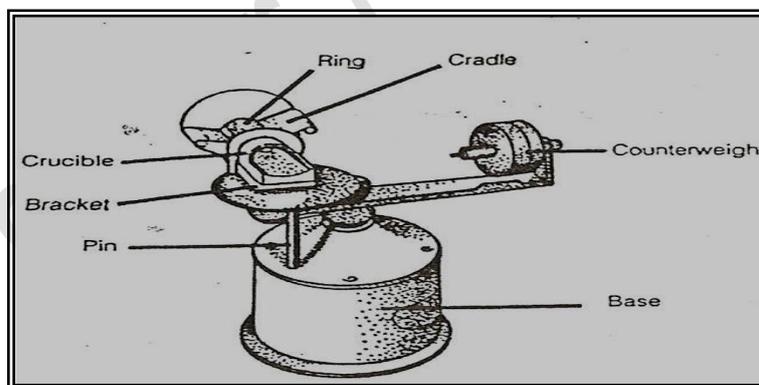


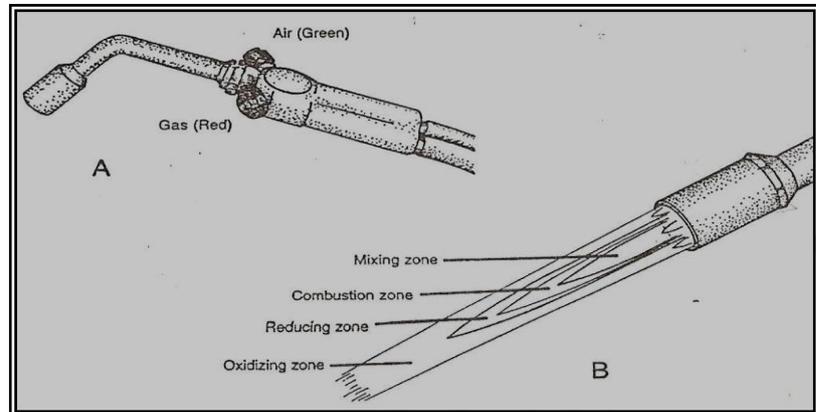
Fig. 4 Parts of casting machine.

**The flame used in the casting composes of 4 zones (fig. 5, B):**

- a- **Mixing zone:** It's cool, colorless zone.
- b- **Combustion zone:** Its greenish-blue zone in which partial combustion takes place, this makes an oxidizing the alloy.
- c- **Reducing zone:** It's a dim blue tip it's the hottest zone.

**D-Oxidizing zone:** In which final combustion between the gas and surrounding air occurs, it makes an oxidizing the alloy.

**Fig. 5,** B Flame's zones.



## CASTING TECHNIQUE

1. The mold is not removed from the burnout furnace until the alloy has been melted and is ready to cast.
2. Cleaning a previously cast alloy is necessary to remove investment debris and oxides before its reuse.
3. Noble metal alloys can be melted on a charcoal block with a gas-air torch, which provides a reducing atmosphere, and remaining impurities are removed through pickling and ultrasonic or steam cleaning.
4. Alloys from different manufacturers should not be mixed, even if they are similar. Overheated or otherwise misapplied alloys, as well as grindings and old restorations, should be returned to the manufacturer as scrap materials, rather than being reused.

### ***Crown and ridge Prosthodontics***

**Dr. Sahar Abdul Razzaq**

***Lecture 7***

### **Casting procedure:**

1. The casting machine is given three clockwise turns (four if using metal-ceramic alloys) and locked in position with the pin.
2. The counterbalance weights check for the appropriate size of the casting ring.
3. A crucible for the alloy being cast is placed in the machine.
4. The torch is lit and adjusted (gas-air for regular alloys, gas oxygen for metal-ceramic).
5. The crucible is preheated particularly in the area that will be in contact with the alloy, and the alloy is added. Preheating avoids excessive slag formation during casting. Also, when metal, ceramic alloys are cast, a crucible that is too cool can "freeze" the alloy, resulting in an incomplete casting .
6. Sufficient mass of alloy must be present to bear adequate casting pressure. With a high-density noble metal alloy, 6 g is typically adequate for premolar and anterior castings, 9 g is adequate for molar castings, and 12 g is adequate for pontics .
7. The alloy is heated in the reducing part of the flame until it is ready to cast.
8. A little flux can be added to conventional gold alloys (not metal ceramic alloys). Gold alloys ball up and have a mirror- like shiny surface that appears to be spinning. Nickel-chromium and cobalt alloys are ready to cast when the sharp edges of the ingot round over.
9. The mold is placed in the cradle of the casting machine and kept on the alloy with the reducing flame until the crucible is moved into position .
10. The casting machine arm is then free to make the casting. The machine is allowed to spin until it has slowed enough that it can be stopped by hand, and the ring is removed with casting tongs.

### **Dental casting alloy:**

May select from alloys based on palladium, silver, nickel, cobalt, and titanium, among others. Furthermore, alloys within each of these groups are diverse. Because of the long-term role, these materials play in dental treatment, the selection of an appropriate alloy is critical from technical, ethical, and legal perspectives. Although uses for pure metals such as gold foil and platinum foil exist in dentistry, the main role of metals in dentistry has been in alloys.

### **Properties of alloys:**

**Color:** The color of alloys is often described as being “yellow” or “white.” These limited terms are inadequate because the range of alloy colors is much greater, including reddish, brownish, and even greenish.

### **Phase structure:**

If most of the components of the alloy dissolve into one another, the alloy is described as a single-phase alloy and has a more or less homogeneous composition throughout. If one or more components are **not soluble** at the other, then two or more phases form in the solid state, each having a different composition. In this case, the alloy is described as a multiple-phase alloy. Single-phase alloys are generally easier to manipulate (ie, easier to cast) and have lower corrosion rates than multiple phase alloys; however, multiple-phase alloys may be etched for bonding and may be significantly stronger than single-phase alloys.

### **Grain size:**

Grains are crystals of the alloy that form upon solidification from the small central part, much as ice crystals form water the size of the grains is influenced by factors such as the cooling rate of the alloy and the composition of the alloy. For gold-based alloys, a small grain size has been shown to improve tensile strength and elongation.

### **Strength and hardness:**

Tensile strength above 300 MPa is necessary to **avoid fracture** of alloys in **high-risk** areas such as between **pontics of a multiple-unit** fixed restoration. Because tensile strength is difficult to measure in practice, the hardness of an alloy must be sufficient to resist wear from opposing teeth or restorations and not so hard as to wear enamel and other materials such as porcelain.

### **Alloy solidus and fit:**

When a molten alloy solidifies from the liquid state during casting, a large amount of shrinkage occurs, but is compensated for by the addition of molten metal from the reservoir in the casting ring. The higher the solidus temperature, the more shrinkage occurs. The shrinkage must be compensated for by the expansion of the die, application of die spacers, the use of special expanding investment mechanisms, or increasing the burnout temperature of the investment. The risk of ill-fitting crowns is much greater for alloys with high solidi, and this factor is a significant consideration in the choice of alloys.

### **Corrosion:**

Corrosion may compromise the strength of the restoration, leading to catastrophic failure or the release of oxidized components may discolor natural teeth, porcelain veneers, the electrons released during corrosion may be detectable by the patient as a shock that can be worrying. Released metallic components may cause an undesirable metallic taste leading the patient to request that the restoration is removed. Because corrosion generally results in

the release of mass from the alloy into the oral environment, it is related in complex ways to alloy biocompatibility.

### **Biocompatibility:**

Biocompatibility is best described as how an alloy interacts with and affects biologic systems.

### **Soldering:**

Soldering of alloys is highly dependent on the type of alloy and may be a significant factor in the clinician's choice of alloy. In general, gold-based alloys are most easily soldered compared with palladium-, nickel-, silver-, or nickel-based alloys. Furthermore, the heating that occurs during soldering is more likely to alter complex phase structures of base-metal alloys than of high-noble alloys.

### **Classification of casting alloys by physical properties:**

ADA designation    Yield strength (MPa, in tension)    Elongation (%)

**Soft** < 140    18

**Medium** 140 – 200    18

**Hard** 201– 340    12

**Extra-hard** > 340    10

**High-noble alloys**

# ***Crown and ridge Prosthodontics***

**Dr. Sahar Abdul Razzaq**

## ***Lecture 8***

### **Cleaning Of Cast Restorations:**

After casting procedure is completed, the casting ring is taken immediately from the casting machine, and thrust or plunged under running cold water into a large mixing rubber bowl. This procedure is called **Quenching**.

### **Purposes or Benefits of Quenching:**

1. To anneal the alloy to provide better working qualities during finishing.
2. The disintegration of the hot investment material when it contacts cold water.

### **Laboratory Seating & Adjustment:**

1. Clean casting and remove oxides
2. Seat on die
3. Adjust interproximal contacts
4. Adjust occlusion
5. Final laboratory polish

### **Cleaning of the cast restoration:**

1. After quenching the cast restoration is cleaned from the remnants of investment material by a sharp hand instrument and a tooth brush.
2. The cast restoration is sandblasted to remove the remaining residues of the investment material. (**Sandblast:** it is a machine that throws sand and compressed air on the cast restoration to clean it)
3. The cast restoration was then placed into a pickling solution (**a solution made of 50% hydrochloride acid**). This procedure is called Pickling.

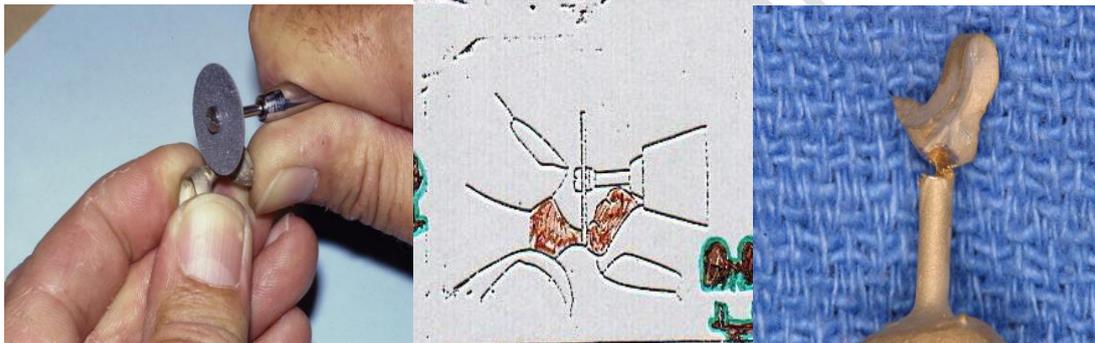
### Advantages;

1. It is used to remove oxide from the surface of the metal.
2. It is used to remove any remnant of investment material
3. The casting restoration is ready now for **finishing procedure**.

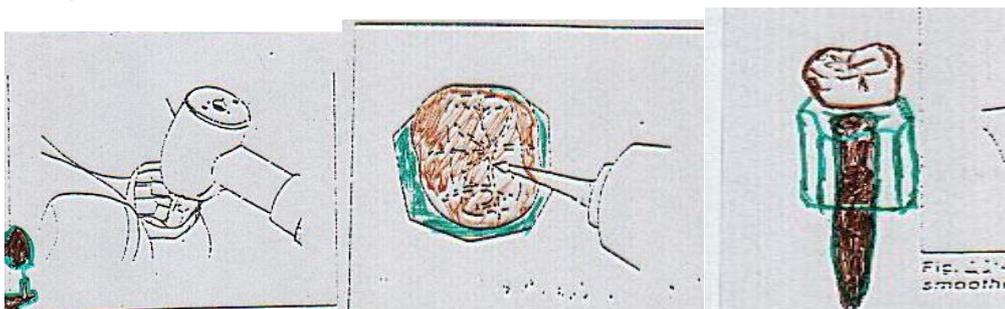
### Finishing of the Cast Restoration:

1. The sprue is cut by a Carborundum separating disc, sometimes we can use cutting pliers or wire cutter, but it's not recommended because they generate stress that could lead to distortion of casting. The excess in the cut area was then removed, recon toured and refined with a stone and a sand disc to reestablish the proper coronal morphology of the cast restoration.

Remove sprue leaving a little excess for finishing



**2. The next step** is to seat the casting on the die, **prior to seating**, inspect the inner surface of the cast restoration for any nodules, bubbles of the metal that might interfere with seating of the cast restoration on the die ( sometimes we use magnification). All these irregularities should be removed using a round bur rotating at high speed



3. The cast restoration (crown) is seated on the die. It should seat without any pressure, if there is any interference, and then the inner surfaces of the cast restoration is inspected again and relieve any contact areas until complete seating with no pressure is obtained. If the cast restoration is seated with pressure the die will be cracked and distorted.



4. After the complete seating of the cast restoration on the die, the die with the casting on were transferred to the working cast and slowly adjusts the interproximal relationship to achieve a slight contact with the adjacent teeth and complete seating of the die into its position on the working cast.



5. Adjust the occlusal relationship in centric and eccentric relation to relieve any occlusal prematurity's. Occlusion is checked and the occlusal contact

reestablished in static as well as dynamic relationships to the opposing arch.

Articulating paper can be used for this purpose, Be certain of complete seating of the casting otherwise you might, ground out of occlusion

6. The axial walls of the cast restoration are smoothed by a rubber wheel bur. The area near the margin of the cast restoration is smoothed by placing the wheel bur parallel to the margin. Afterwards, the occlusal surface is finished with the use of small finishing burs.



**Now the cast restoration is ready to be tried in the patient's mouth.**

# ***Crown and ridge Prosthodontics***

Dr. Sahar Abdul Razzaq

*Lecture 9*

## **Types of the casting Defects**

<b>No.</b>	<b>Problem</b>	<b>Cause</b>	<b>Rimed</b>
<b>1</b>	Mixing consistency too thick or too thin.	Incorrect mixing ratio of the powder to liquid.	Observe mixing ratio stated in the instruction manual
<b>2</b>	Investment sets too quickly	Powder and/or liquid too warm.	Ideal processing tempera true 18°-22°C / 64°-72°F.
<b>3</b>	Investment sets too slowly or not at all.	-Mixing container dirty (plaster, soap, electrolyte, oil). - Moisture in investment material. -Investment material or liquid too cold.	-Keep mixing container clean. -Do not allow the powder bag to remain open. -Observe the recommended processing temperature. -Store investment and liquid at the room temperature 18°-22°C / 64°-72°F.
<b>4</b>	Formation of cracks in ring	-Setting time too short.  -Ring allowed to bench set too long and has dried out.	-Observe setting time of 40 minutes.  -Place the ring in the burnout furnace after 40 minutes The setting time. Keep ring moist over the weekend or dry on the same day at 250°C / 482°F.

		<ul style="list-style-type: none"> <li>-Incorrect or too rapid Preheating of the ring.</li> <li>- Use of solid plastic parts.</li> <li>- Pressure investing.</li> <li>- Steam de-waxing.</li> <li>- Liquid crystallized.</li> <li>- Liquid with red film (bacteria formed).</li> </ul>	<ul style="list-style-type: none"> <li>-Place the ring in the cold burnout furnace. Heat up slowly (5°C / 41°F per min) and observe holding time of one hour at 250°C / 482°F.</li> <li>-Solid plastic parts (sprues) must be coated with wax.</li> <li>- Not recommended.</li> <li>- Not recommended.</li> <li>- Use fresh liquid and keep tightly closed.</li> <li>- Liquid stored too long or not properly closed. Use fresh liquid.</li> </ul>
<b>5</b>	Cracks in ring.	<ul style="list-style-type: none"> <li>-Liquid stored too cold or ordered during cold weather.</li> <li>- Dirty mixing bowls and beakers.</li> <li>- Invested with liner without a metal ring.</li> <li>- Wrong positioning of the ring in burnout furnace.</li> </ul>	<ul style="list-style-type: none"> <li>- Order before the beginning of winter.</li> <li>Do not store liquid under 5°C / 41°F.</li> <li>- Always keep the bowls clean. Do not use them for plaster or clean with soap.</li> <li>- Use metal rings.</li> <li>- Place rings in the burnout furnace with casting funnel pointing downwards.</li> </ul>

### Effect of impact.

No.	Problem	Cause	Rimed
6	<p>Casting not complete.</p> <p>Round holes in crowns and/or round cervical edges.</p>	<p>Ring temperature too low.</p> <p>- Casting (release of the centrifuge) delayed too long.</p> <p>- Melt too cold.</p> <p>- Ceramic crucible not preheated.</p> <p>- The insufficient twist in a centrifuge.</p> <p>- Wrong position of casting object in the ring.</p> <p>- The wax up too thin.</p> <p>- Wrong or thin sprues.</p>	<p>-Allow the ring to soak long enough at the correct temperature (see instructions) (30 minutes - 1 hour).</p> <p>-Check the final temperature of the burnout furnace. (If necessary re-calibrate burnout furnace).</p> <p>- Check burnout furnace temperature. Casting delay time not over 40 seconds</p> <p>Pre-melt metal.</p> <p>- Follow instructions for the melting metal.</p> <p>- Heat crucible.</p> <p>- Check centrifuge.</p> <p>- Crowns should not be covered more than 8 mm with the investment material (air block). Do not place the crowns too close to the ring edge.</p> <p>- The Minimum thickness of the wax -up, 0.4 mm. Use thicker sprues or runner bar.</p>

7	<p>Rough casting surface.</p> <p>- Rough casting surface.</p>	<p>-Metal overheated.</p> <p>- Care required with <u>vacuum pressure casting</u> devices in combination with <u>high melting point alloys</u>.</p> <p>-Ratio of reused metal too high.</p> <p>- Ring held too long at casting temperature.</p> <p>- Incorrect use of wax surface tension reducer.</p>	<p>- Cast colder. (With Dent aurum C+B alloys) and use of high frequency, shot centrifuge immediately when oxide skin begins to crack.</p> <p>Take care when using electric arc melting machines.</p> <p>- Depending on the alloy, use at least 50% new material. With Dent aurum CS, 2000 and CD use only new metal.</p> <p>- Do not hold at the final temperature longer than 1.5 hours.</p> <p>- Wax surface tension reducer must always be inflated dry.</p>
8	<p>Beads on casting surface.</p>	<p>-Investment mixed without vacuum or with an inadequate vacuum.</p> <p>-Wax surface was not tension reduced.</p>	<p>- Use efficient vacuum mixing unit and stir for 60 seconds.</p> <p>- Use the wax tension reducer (Lubro-film ).Important: blow dry.</p>
9	<p>Inclusions of investment material in casting.</p>	<p>Sprues and funnel formers not properly waxed.</p>	<p>Correct waxing of sprues</p>
10	<p>Molder cervical</p>	<p>Wax surface tension</p>	<p>Wax surface tension reducer</p>

	<p>edges, sharp edged porosity in the casting.</p> <p>- Frayed cervical edges, sharp -edged porosity in the casting.</p>	<p>reducer not correctly used.</p> <p>- Ring pre-heated too quickly.</p> <p>- Ring setting time too short or standing time too long.</p> <p>-Solid plastic parts used.</p> <p>-Adhesive for retention beads not suitable.</p> <p>-Investment material inclusions.</p>	<p>must always be blown dry.</p> <p>-See processing instructions for investment material.</p> <p>- Setting time 40 minutes (ring must not be allowed to dry out).</p> <p>-Use plastic only when it burns without residue and is coated with wax.</p> <p>-Change retention adhesive.</p> <p>-Wax connections correctly.</p>
<b>11</b>	<p>Crowns flooded, i.e broken investment dies.</p>	<p>-Wax surface tension reducer used incorrectly.</p> <p>- Pressure investment.</p> <p>- Steam de-waxing.</p> <p>- Pre-heating of ring too rapid.</p>	<p>- Wax surface tension reducer (Lubro film) must be blown dry.</p> <p>- Not recommended.</p> <p>- Do not use.</p> <p>- See instructions for processing investment material.</p>

## ***Crown and ridge Prosthodontics***

**Dr. Sahar Abdul Razzaq**

### ***Lectur 10***

#### **Full Metal With or Without Acrylic or Ceramic Facing**

These types of crowns and bridges have a metallic body and prove to be a cost-effective option for posterior teeth. An acrylic or ceramic facing contributes to the aesthetics in such type of restorations. The **advantage** of this type of crown or bridge is **the low cost, the strength of the metal and longevity.** Plus very less tooth structure is **lost while preparing the tooth for a crown or bridge.**

The **disadvantage** is the aesthetics since there is a possibility of the metal showing in cases of acrylic facing **wearing** off due to long-term use.

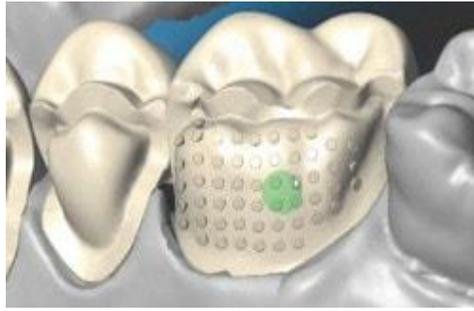
The normal lifespan of such restorations is 6 - 8 years.

#### **Indications**

- When the cost of a porcelain (or composite) restoration is too high for the patient. To overcome the negative consequences of tooth loss, it is very important to restore the edentulous spaces as soon as possible.

This is why an acrylic restoration is better than nothing, at least until the patient will have the financial situation for a superior prosthesis.

- Limited indications for the following cases: elderly persons, people with other acrylic restorations which they don't want to change, very poor persons.
- Temporary crowns or other temporary restorations. It is the main indication of acrylic restorations. In this case, the temporary crown doesn't need a metal shell because its life span is very short (until the definitive restoration is completed).



### **Metal frame**

The metal shell can be constructed from various types of metal alloys (chromium /nickel, chromium/cobalt etc.). Normally, base metal alloys are utilized but it is possible to use noble alloys as well.

Basically, the metal frame covers the full tooth; on the visible part, it has a **special "window"** which is carved inside the metal shell (The acrylic is placed inside this window and is held in place by small metal "dots").

### **Acrylic resin**

Acrylic resins are plastic materials that are processed by means of polymerization in special furnaces at 150-200 degrees. Most often, the crowns are made with a partial acrylic veneer that covers only the aspects of the crown those are visible while the rest of the crown remains bare metal. It is not indicated to place acrylic resins on the occlusal side of teeth because of the **low resistance**.



*Dental crown with partial acrylic veneer*

## Disadvantages

- Weak resistance and durability
- Smaller range of shades and a lower possibility of combining them, hence inferior aesthetics
- No translucency
- Weak connection with the metal part. This may lead to the detachment of acrylic veneers
- Normally, it has a low cost

## Uses

1. Definitive acrylic restorations have limited indications nowadays. They are normally utilized when patients cannot afford more expensive (and superior) dental restorations: zirconia, porcelain etc.
2. Temporary acrylic restorations are widely used. Temporary crowns are usually manufactured without a metal frame and their main function is to protect the prepared teeth until the definitive restoration is completed.

## What Types of Crowns Are Available?

**1. Stainless steel crowns:** Fabricated crowns that are used on permanent teeth primarily as a temporary measure. The crown protects the tooth or filling while a permanent crown is made from another material.

**2. Metals used in crowns:** Include alloys that have a high content of gold or platinum, or base-metal alloys (for example, cobalt- chromium and nickel-chromium alloys). Metal crowns withstand biting and chewing forces well and probably last the longest in terms of wear down.

**3. Porcelain-fused-to-metal:** Dental crowns can be color matched to your adjacent teeth (unlike the metallic crowns). However, more wearing to the opposing teeth occurs with this crown type compared with metal or resin crowns. The crown's porcelain portion can also chip or break off.

**4. All-resin:** Dental crowns are less expensive than other crown types.

However, they wear down over time and are more prone to fractures than porcelain-fused-to-metal crowns.

**All-ceramic or all-porcelain:** Dental crowns provide better natural color match than any other crown type and may be more suitable for people with metal allergies. All-ceramic crowns can be used for front and back teeth.

### **Procedure**

1. After finish full wax, mark the cavity margins with the red pencil so that you can clearly identify them all around.
2. The LeCron will refine the whole morphology, removing all flash and excess material so that no wax is extending over the pencil mark. Lay the sharp cutting side of the carver on a cusp (around 45° inclination) with the point of the instrument in the groove at the center of a tooth. Scrape away the excess wax following the line of the cusps. The marginal ridges should be at the same level as the adjacent.
3. In the presence of voids or if too much wax was removed, add an appropriate amount of wax back by repeating and recarve. Polish your restoration with a toothbrush, gauze, and/or a piece of nylon or cotton.

### **General wax-up characteristics:**

- Margins:** Wax should be flush with the margin of the tooth preparation with no overhangs or sub margins.
- Contour:** Should be smooth and curved with no flat (under) or bulbous (over) contour.
  - Outer surfaces** (facial, lingual, mesial, distal): Should respect proper convexity, appear smooth, even and polished (with no scratches, waviness or voids).

□ **Morphological structures:** All ridges, fossae, cingulum area and grooves should exhibit a polished surface with no scratches. The junctions between these structures should flow naturally.

The frame has a greater thickness and it is not so closely adapted from the underneath tooth.

The contacts with neighboring teeth are carefully shaped and all details from the **occlusal side (cusps and grooves) are built up in wax.** Because the aesthetic materials are normally placed only on the visible side of the tooth, the rest will remain bare metal. The bite is carefully checked.

**The aesthetic material** (acrylic or composite) will be positioned in a specific window carved inside the wax. The window may contain small retention beads that will hold the aesthetic material in place.

# ***Crown and ridge Prosthodontics***

**Dr. Sahar Abdul Razzaq**

## ***Lectur 11***

### **Pontic:**

Pontic: An artificial tooth that suspended a member of the fixed dental prosthesis that replaces a missing natural tooth restores its esthetic and function, it replaces the space previously occupied by the missing clinical crown. They must be compatible with continued oral health and comfort. The part that connects the Pontic to the abutment is the retainer which is either:

- 1- The rigid (ex. fixed by solder joint) the retainer is called major retainer.
- 2- When the connection is not rigid (flexible) ex. Stress breaker, the retainer is called minor retainer.

The Pontic rigidly attached to crowns on the abutment teeth. The connectors should occupy the normal interproximal contact area and be large enough for strength but not so large as to impede plaque control.

### **Benefits:**

- **Replacing** a missing tooth can prevent the other teeth from shifting in ways that can lead to further oral problems and cause discomfort for the patient.
- **Curved teeth**, which can result from shifting caused by the missing tooth, can lead to further tooth decay and periodontal disease because cleaning between them is difficult. This can lead to further tooth loss.
- Pontics and their attachments provide **support for facial muscles, improve**

**oral functions such as speech and chewing ability, and enhance one's smile and general facial appearance.**

### **Reasons for Getting Pontics:**

- Correct a malocclusion, or bad bite .
- Keep the shape of your face intact.
- Reinstate your ability to bite properly.
- Reduce your risk of gum disease.
- Improve your ability to chew properly.
- Improve your speech.

### **Pontic design principles:**

1. The inter proximal embrasure should be large for good self-cleaning in posterior teeth in anterior is less Bucco lingually for esthetic.
2. Tissue covered must be minimized to give good health to the gingiva.
3. The occlusal surface should be reduced about 20% width and the depend on the: **a- length of the span. B- strength of the tooth. C-Ridge form.**
4. Tissue contact: The Pontic must touch the gum, but without the pressure and the surface which face the tissue is best from porcelain or gold and not at the junction line between the gold with porcelain.
5. Length of span: The more length of span it needs more strength of the bridge, especially in the joint also using a hard metal alloy to tolerate the excessive occlusal force.

6. The relationship of the ridge to Pontic design it should be concave buccolingual and convex mesiodistally and thus the surface can be carved in such design to cover the mucosa with the same shape.

- **Biologic principles:**
- These include cleanable tissue surface, access to abutment teeth and no pressure on the ridge.
- **Mechanical principles:** These include strong connectors to prevent fracture.
- Rigidity to resist deformation and material choice to resist porcelain fracture.
- **Esthetic principles:** These have to include looking like the tooth it's replacing, appearing to "grow" out of the ridge and have space for porcelain design.

#### **Pontic designed according to the shape:**

1-Saddle pontic.

2-Ridge lap

3-Modified ridge lap.

4-Ovate.

#### **Saddle Or Ridge Lap Pontic:**

The saddle pontic has a concave fitting surface that overlaps the residual ridge buccolingual, simulating the contours and development profile of the missing tooth on both sides of the residual ridge. However, saddle or ridge lap designs should be avoided because the concave gingival surface of the pontic is not accessible to cleaning with dental fiber, which will lead to plaque accumulation.

**Modified ridge lap poetic:** This type of poetic demonstrates acceptable esthetics and works best with broad edentulous ridges.

**Stein Pontic:** This type of poetic, which is designed for sharp edentulous ridges, demonstrates minimal tissue contact and acceptable esthetics. It is contraindicated in edentulous ridges with broad bucco-lingual dimensions.

**Sanitary Pontic:** This type of poetic is 2 to 3 mm distant from the ridge. This design is easily cleaned and allows for a free flow of food beneath the poetic. However, it exhibits unacceptable esthetics.

**Renovate Pontic:** This type of poetic exhibits excellent esthetics and function. It produces minimal tissue contact and is very hygienic. However, if ridge resorption occurs, deterioration of esthetics results.

**For instance, ovate and modified ridge lap is recommended for the anterior maxilla, sanitary and modified ridge lap for the posterior maxilla, conical, and modified ridge lap for the anterior mandible and sanitary for the posterior mandible, respectively.**

# ***Crown and ridge Prosthodontics***

**Dr. Sahar Abdul Razzaq**

***Lectur 12***

## **Metal frame construction**

Most of the times, dental crowns, dental bridges and some removable partial dentures need a supporting frame that is designed to provide strength for the entire restoration and to support the aesthetic materials (porcelain, composite, acrylics). All details in the next. The fabrication of the metal core is a process that requires patience and time. Various types of metal alloys can be used: noble metal alloys (gold, palladium) or base metal alloys (chromium-nickel, chromium-cobalt or titanium).



The procedure is performed on the dental cast; several steps are involved:

### ***1. Wax-up***

The first step is to build up the metal frame using a wax-up technique. Basically, the entire metal core is carved in wax at the accurate shape and size considering all aspects requested by the particular clinical situation. There are various types of wax up techniques and the buildup directly depends on the type of restoration that is manufactured. If, for example, a large dental bridge is constructed, first the metal frames for all retainer

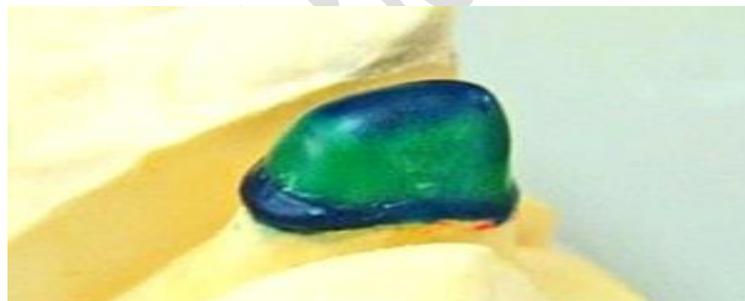
crowns are modeled. After that, the pontics are sculpted between the retainer crowns.

### **a. Wax-up for dental crowns metal frame**

The technique depends on the type of restoration that is fabricated: porcelain fused to metal crowns have a differently shaped (and sized) metal frame compared to dental composite or acrylic crowns.

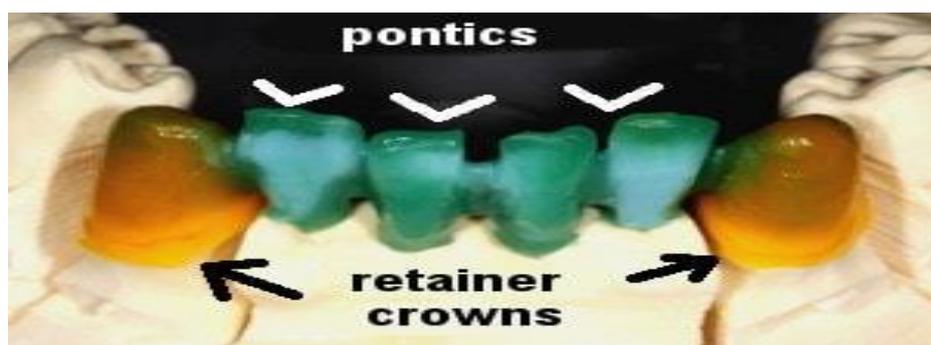
#### **Porcelain fused to metal crowns**

A smooth and thin (0.3-0.5 mm in thickness) "cap" is modeled; the cap is closely adapted to the prepared tooth. The cap is distanced from the adjacent and opposing teeth (1.5 to 2 mm) so that all porcelain layers can be correctly built up on top of the frame.



*porcelain crown metal frame wax up*

When aesthetic materials are placed all around the metal frame, the frame is distanced from opposite teeth to create enough space for porcelain build-up.



*porcelain fused to metal dental bridge; metal frame wax-up front view*



*porcelain fused to metal dental bridge; metal frame wax-up back view*

**Dental ceramic:** Is one of the most biological and esthetically acceptable materials in dentistry.

Ceramics are used for manufacturing artificial teeth, Pontics, facing, crowns and fixed bridges.

**The term Ceramic is defined** as any product made basically from a nonmetallic material by firing at a high temperature to achieve desirable properties.

#### **Advantages of all ceramic restorations**

- Superior esthetics.
- High biocompatible because it is inactive.
- Low thermal conductivity: no thermal shock to the prepared tooth.
- No electrolytic corrosion.
- No metal preparation: no metal inhaled during metal finishing.
- Excellent bonding between the porcelain veneer and ceramic coping.
- No repeated firing no distortion of infra-structure.
- Resistant to degradation to oral fluids.



**Ceramics:** Compounds of one or more metals with a nonmetallic element (usually silicon, boron, oxygen) that may be used as a single structural component or as one of the several layers that are used in the fabrication of a ceramic-based prosthesis.

**The various components used in different formulations of ceramics are:**

1. Silica (Quartz or Flint) – Filler.
2. Kaolin (China clay) – Binder.
3. Feldspar – Basic glass former.
4. Water – Important glass modifiers
5. Fluxes – Glass modifiers.
6. Color pigments
7. Opacifying agents.
8. Stains and color modifiers
9. Fluorescent agents.
10. Glazes and Add-on porcelain
11. Alumina.
12. Alternative additives to porcelains.

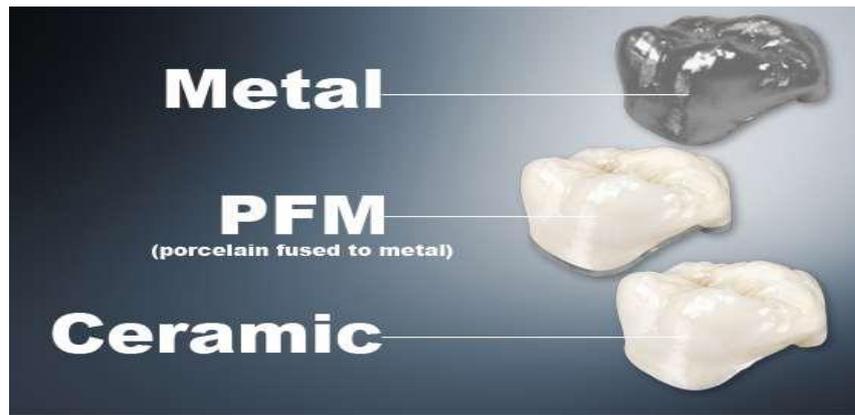
### **Classification of Dental Ceramics**

**Dental ceramics can be classified according to:**

1. Fusion Temperature.
2. Application
3. Fabrication Technique.
4. Crystalline Phase.

**Fusion temperature can be classified to**

1. High-fusing ceramics (1315° to 1370° C).
2. Medium-fusing ceramics (1090° to 1260° C).
3. Low-fusing ceramics (870° to 1065° C).
4. Ultra-low-fusing ceramics (below 870° C).



- One of the most common fabrication techniques for dental ceramics is called Sintering.
- Sintering is the process of heating the ceramic to ensure densification. This occurs by viscous flow when the firing temperature is reached.

#### 4. Crystalline Phase

After firing, dental ceramics are composed of two phases: a glassy phase surrounding a crystalline phase.

- Increasing the amount of glassy phase lowers the resistance to crack propagation but increases translucency.
- Materials for all-ceramic restorations have increased amounts of the crystalline phase (between 35% and 90%) for better mechanical properties.

#### Ceramic-Metal Restorations (or) Porcelain Fused to Metal



### Composition:

1. In its mineral state, feldspar, the main raw component of dental porcelains, is crystalline and opaque with an unspecified color between gray and pink.

Chemically it is specified as Potassium Aluminum Silicate, with a composition of  $K_2O \cdot Al_2O_3 \cdot 6SiO_2$ . the fusion temperature of feldspar varies between  $1125^\circ$  &  $1170^\circ$  C, depending on its purity.

2. Pure Quartz ( $SiO_2$ ) crystals are used in dental porcelain and ground to the **finest grain size possible**. **Silica is added, and contributes stability to the mass during heating** by providing a **glassy framework** for the other components.

### Manufacture:

After the manufacturing process is completed, Feldspathic dental porcelain consists of two phases. One is the **glass phase**, and the other is the **crystalline (or mineral) phase**.

### Processing:

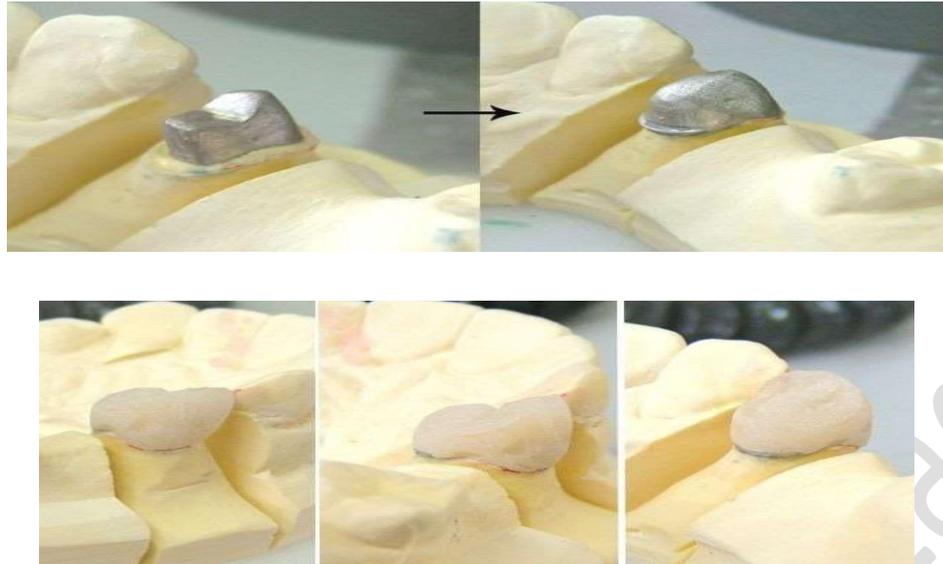
1. Porcelain Application & Condensation

2. Drying.

4. Glazing.

3. Firing/Sintering

5. Cooling



**Several processing techniques are available for fabricating all-ceramic crowns:**

1. Sintering.
2. Heat-pressing
3. Slip-casting.
4. Machining



### **1. Sintering:**

Two main types of all-ceramic materials are available for the sintering technique:

- A. Alumina-based ceramic
- B. Leucite-reinforced ceramic

### **Alumina Core Ceramics:**

Alumina has a high modulus of elasticity and high fracture toughness.

**The resulting** restorations were approximately 40% stronger than traditional feldspathic porcelain.

It contains an opaque inner core containing 50% by weight alumina for high strength.

Core is veneered with matched expansion porcelain due to its inadequate translucency.

### **Role of feldspar:**

Glass phase formation: During firing, the **feldspar** fuses and forms a glassy phase that softens and flows slightly allowing the porcelain powder particles to **integrate together**. The **glassy phase** forms **a translucent glassy matrix**.

Leucite formation: **Another important** property of feldspar its tendency to form the crystalline mineral leucite.

### **Functions of Leucite:**

To raise the coefficient of thermal expansion of porcelain and bring it **closer to that of the metal** substrate; consequently increasing the hardness and fusion temperature.

## **2. Heat-pressed:**

Heat-pressing relies on the application of external pressure to sinter and shape the ceramic at high temperature. Heat-pressing is also called high-temperature injection molding. The advantages of heat-pressed ceramics **include good esthetics, high strength (but higher opacity)**. Processing **times are short and margin accuracy** is within an acceptable range.



### 3. Slip-casting:

- Slip-casting involves the condensation of an aqueous porcelain **slip on a refractory die.**
- Materials processed by slip-casting tend to exhibit **reduced porosity, fewer defects from processing, and higher toughness than conventional feldspathic porcelains.**

