

## Impression for crown and bridge work

**Definition:** an impression is a negative reproduction or likeness of an object, from which, a positive reproduction (or cast) could be obtained.

### Objective of taking an impression

Because it is neither possible nor desirable to make patterns for fixed prostheses directly in the mouth, an impression or negative likeness of the teeth and surrounding structures is necessary to obtain a cast. This cast is then used to make a restoration in the laboratory. To obtain the cast, an elastic impression material is placed in a tray that is inserted into the patient's mouth. When the material has set, it is removed from the patient's mouth. A suitable dental stone is then poured into the "negative" impression, and a positive likeness or working cast is obtained.

### Requirements of an acceptable impression

1. An acceptable impression must be an exact record of all aspects of the prepared tooth. This means that it must include sufficient unprepared tooth structure immediately adjacent to the margins so that the restoration could be fabricated with proper contour by the laboratory technician.
2. All teeth in the dental arch and the soft tissues immediately surrounding the prepared tooth must be reproduced in the impression. This will allow the cast to be accurately articulated and contribute to proper contouring of the planned restoration.
3. The impression must be free of air bubbles, tears, thin spots, and other imperfections that might induce inaccuracy.

### Requirements of an impression material

1. It should be *elastic* after its placement in the patient's mouth so that it can be removed from the undercut areas that exist on the external tooth surfaces adjacent to the prepared tooth without distortion or fracture.
2. It should have adequate *strength* to resist breakage or tearing on removal from the patient's mouth (*adequate tear strength*).
3. It should have adequate *dimensional stability* over temperature and humidity ranges normally found in clinical or laboratory procedures for a period long enough to permit the production of a cast or die.
4. It should have adequate *accuracy* for the production of the fine details so that it is an exact negative reproduction of the prepared and unprepared teeth.
5. It should be *easy to use with the minimum of equipment*.
6. It should be *free of toxic or irritating components*.

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## **Classification of impression materials**

### **1. Non-elastic impression materials:**

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

These materials are not used routinely in crown and bridge work because when they set they become rigid, so upon removal from the undercut areas they will fracture.

### **2. Elastic impression materials:**

- a. Hydrocolloids (water-based systems):
  - Reversible hydrocolloids (agar impression material).
  - Irreversible hydrocolloids (alginate impression material).
- b. Elastomers:
  - Polysulfide impression material.
  - Condensation silicone impression material.
  - Polyether impression material.
  - Addition silicone impression material.

## **Hydrocolloids**

### **-Reversible hydrocolloids (agar impression material)**

Agar hydrocolloid impression material is compounded from reversible agar gel. It is termed *reversible* because as the agar gel is heated, it will liquefy or go into a sol state, and on cooling it will return to the gel state. Because this process can be repeated, a gel of this type is described as *reversible*.

### **Chemical composition of agar impression material**

The main active constituent of reversible hydrocolloid impression product is agar, which is a sulfuric ester of a galactan complex, potassium sulfate, borax, alkyl benzoate, water, coloring agent and flavors. This material forms a colloid with water, which liquefies between 71°C and 100°C and sets again to a gel again between 30°C and 50°C, varying with the concentration of the agar.

The material is supplied as a tray type and a syringe type. The tray type is considerably stiffer at the time of making the impression than the syringe type. The agar content is reduced in the syringe type, so it is much more fluid at the time of injection than is the tray material at the time of insertion.

### **Advantages of agar impression material**

1. If poured immediately, it produces casts of excellent dimensional stability, accuracy, and surface details.
2. A special tray is not required when agar impression material is used. This is because its accuracy is improved if the material has as much bulk as possible. This is in contrast with the elastomeric impression materials (polysulfide and condensation silicone) whose accuracy is improved by minimizing the bulk by using a special tray.

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## **Disadvantages of agar impression material**

1. Special equipment and water-cooled impression trays are needed.
2. If the agar impression is not poured immediately, it will undergo dimensional changes. This is due primarily to the ease with which water can be released from or absorbed by the material (syneresis and imbibition). In order to avoid this, the impression should be poured immediately, or if this cannot be done immediately, the impression should be stored in 100% relative humidity.



**The special equipment and the water-cooled impression trays needed for the agar impression material.**

## **-Irreversible hydrocolloids (alginate impression material)**

### **Chemical composition of alginate impression material**

It is supplied as a powder which is composed of sodium or potassium alginate, salts of alginic acid, fillers (diatomaceous earth), calcium sulfate, and modifiers. On mixing the powder with water a sol is formed, a chemical reaction takes place and a gel is formed.



### **Properties**

- Good surface detail.
- Reaction is faster at higher temperatures.
- Elastic enough to be drawn over the undercuts, but tears over the deep undercuts.
- Not dimensionally stable on storing due to evaporation.
- Non toxic and non irritant.
- Setting time can depend on technique.
- Alginate powder is unstable on storage in presence of moisture or in warm temperatures.

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## **Advantages**

1. Non-toxic and non-irritant.
2. Good surface details.
3. Easy to use and handle.
4. Cheap and has good shelf-life.
5. Its setting time can be controlled by controlling the temperature of water used.

## **Disadvantages**

1. Poor dimensional stability (syneresis and imbibition); therefore, an alginate impression should be cast within 15 minutes.
2. It does not adhere to the impression tray.
3. Setting time very dependent on operator handling.

## **Polysulfide impression material**

The polysulfides, commonly known as "rubber bases", were introduced in the early to middle 1950s and used widely by dentists because of their better dimensional stability and tear strength than hydrocolloids. Nevertheless, it was important that the polysulfide impression be poured as soon as possible after impression taking since delay of over an hour resulted in clinically significant dimensional change.

## **Chemical composition of polysulfide impression material**

The material is supplied as a two-paste system (*base* and *accelerator* or *catalyst*) in three consistencies (heavy, medium, and light bodies) which differ only in the amount of filler loading. The base is composed of polysulfide polymer, titanium dioxide, zinc sulfate, copper carbonate, or silica. The accelerator or catalyst is composed of lead dioxide, dibutyl or dioctyl phthalate, sulfur, and other ingredients as magnesium stearate and deodorants.

Water is a by-product of polysulfide polymerization. Its evaporation results in a slight contraction of the polymerized material, which can be minimized through the use of a special tray as this reduces the material's thickness.



## **Advantages of polysulfide impression material**

1. It has high tear resistance and high elastic properties which facilitate impression making in sulcular areas and pinholes.
2. It has improved dimensional stability over hydrocolloids but inferior to polyether and addition silicone.
3. It is the least expensive of elastomers.

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### **Disadvantages of polysulfide impression material**

1. It has dimensional instability which is due to the mode of polymerization of polysulfide which is of condensation type which gives off water as a by-product, whose evaporation from the set material causes dimensional contraction.
2. It has a long setting time in the mouth (typically 10 minutes) which induces poor patient's acceptance (especially in view of its unpleasant sulfide odor).
3. Humidity and temperature dramatically reduce its working time which may be so short that polymerization begins prior to insertion in the mouth with resultant severe distortion.
4. Most polysulfide materials are polymerized with the aid of lead peroxide (catalyst) which gives the material its typical brown color and the polymerized material is so sticky and should be handled carefully since it could stain the clothes permanently.

### **Condensation silicone impression material**

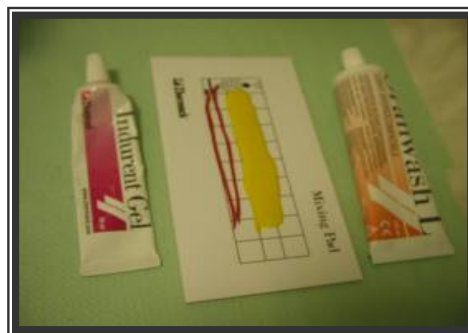
Condensation silicone has been developed to overcome some of the disadvantages of polysulfide. It is odorless and can be pigmented to virtually any shade. An additional advantage of condensation silicone over polysulfide is its relatively short setting time in the mouth (typically 6-8 minutes). As a result patient acceptance is better than polysulfide. It is also less affected by high operator temperatures and humidity. Unfortunately, its dimensional stability is less than that of polysulfide although greater than that of reversible hydrocolloid.

### **Chemical composition of condensation silicone impression material**

The material is supplied as a *base* and an *accelerator* in a low consistency and putty-like consistency. The base is composed of a linear silicone called *polydimethylsiloxane* and fillers (either calcium carbonate or silica). The accelerator may be a liquid that consists of stannous octoate suspension and alkyl silicate, or it may be supplied as a paste by adding a thickening agent.



(A)



(B)

**The condensation silicone impression material: The putty-like (A), and the low consistency (B).**

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### **Disadvantages of condensation silicone impression material**

1. The main disadvantage of condensation silicone is its poor wetting characteristics because it is extremely hydrophobic; therefore, the prepared teeth and gingival sulci must be completely free of moisture for a defect-free impression.
2. It has dimensional instability which is due to the mode of polymerization which is of condensation type which gives off ethyl alcohol as a by-product, whose evaporation from the set material causes dimensional contraction.
3. Pouring the impression made of condensation silicone without trapping air bubbles is more difficult than with other impression materials.

### **Polyether impression material**

Polyether impression material has a polymerization mechanism unlike those of the other elastomers. No volatile by-product is formed, and thus it has excellent dimensional stability.

### **Chemical composition of polyether impression material**

The material is also supplied as a two-paste system (*base* and *accelerator* or *catalyst*) in three consistencies (low, medium, and heavy bodies). The base paste consists of a long-chain polyether copolymer, silica fillers, compatible plasticizers of a non-phthalate type, and triglycerides. The catalyst paste consists of an aliphatic cationic initiator (as a cross-linking agent), silica fillers, and plasticizers. Coloring agents are added to the base and catalyst to aid in the recognition of different materials types.

### **Advantages of polyether impression material**

1. It has high dimensional stability since no volatile by-product is formed and its polymerization shrinkage is unusually low compared with most room temperature-cured polymer systems. Therefore, an impression made of polyether can be poured more than a day after the impression has been made and still having accurate casts. This is especially useful when it may be impossible or inconvenient to pour the impression immediately. The new polyether materials can be poured up to fourteen days after impression taking.
2. It has short setting time in the mouth (typically 5 minutes, or less than half the time required for polysulfide).

### **Disadvantages of polyether impression material**

1. The set material is stiff. This causes problems when separating a stone cast from the impression, especially in thin and single teeth as in the mandibular incisors. However, this problem has been recently solved with the introduction of soft polyether materials such as Impregum Penta Soft.
2. The polyether is stable only if stored dry since it will absorb moisture (imbibition) and significantly change dimensionally.
3. There are reported cases of allergic hypersensitivity to polyether, manifested as a sudden onset of burning, itching, and general oral discomfort.

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## **Addition silicone impression material (polyvinylsiloxane)**

The main difference between the addition silicone and the condensation silicone is that it has much greater dimensional stability than the condensation type as its polymerization reaction does not give off any by-product.

### **Chemical composition of addition silicone impression material**

The material is also supplied as a two-paste system (*base* and *accelerator* or *catalyst*) in extra low, low, medium, heavy, and very heavy (putty) consistencies. The base paste consists of dimethylsiloxane with vinyl terminal groups, plus fillers. The accelerator (catalyst) also contains dimethylsiloxane with vinyl terminal groups, fillers, and platinum catalyst.

### **Advantages of addition silicone impression material**

1. It has high dimensional stability which is equivalent to polyether.
2. The set material is less rigid than polyether.

### **Disadvantages of addition silicone impression material**

1. Like other materials, adverse tissue responses have been reported.
2. Setting inhibition by some brands of latex gloves.

### **Final impression**

To take a final impression, we need a special tray (custom tray), impression syringe, and an impression material.

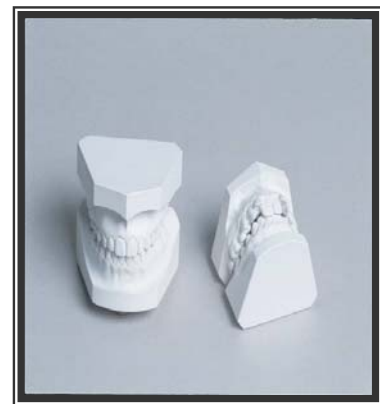
The special tray is constructed on the study cast.



The impression syringe.

### **Advantages of the study cast**

1. It is useful for the diagnosis and treatment planning.
2. It is used for the construction of a provisional restoration.
3. It is used for the construction of a special tray.



The study cast after its removal from the impression and its trimming,

### **Advantages of the special tray**

1. It allows the use of the impression material in minimum thickness, so it reduces its dimensional changes.
2. It reduces the discomfort of the patient because it is well-fitted to the patient's mouth.
3. Its small size prevents the forcible opening of the mouth.
4. It allows free snap removal of the impression from the patient's mouth without applying rotary movement.



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## **Materials used to construct the special tray**

1. Auto-polymerizing acrylic resin (mostly used).
2. Shellac base plate.
3. Vacuum thermoplastic material.

## **Requirements of the special tray**

1. It should be rigid enough to resist breakage; therefore, it should have a thickness of 2-3 mm.
2. It should extend about 5 mm cervical to the gingival margin.
3. It should be stable on the cast with stoppers.
4. It should be constructed at least 9 hours prior to its use.

To construct a special tray, we need:

1. Study cast.
2. Pink base plate wax.
3. Self-cured acrylic resin.

## **Construction of the special tray**

1. With a pencil, we draw a line on the study cast around the dental arch about 5 mm cervical to the gingival margin. This line represents the finishing line of our special tray.
2. We adapt two layers of base plate wax on the study cast. Then we remove the wax from the periphery until we see the line that we have drawn (cut back).
3. After that, we create two perforations in the occlusal surface of the wax (2 posterior and 1 anterior) to obtain stoppers for our special tray. The stoppers are created in the area of non-functional cusps. The stoppers serve the following advantages:
  - They help to equalize the pressure that is going to be applied on the tray.
  - They help to localize the tray in the patient's mouth during impression taking.
  - They maintain even space for the impression material.
  - They prevent sinking down of the impression tray.
4. A layer of tin foil is adapted on the two layers of the wax.
5. Auto-polymerizing acrylic resin is mixed according to the manufacturer's instruction. When it reaches the dough stage, it is adapted on the wax that has been covered with the tin foil. The excess acrylic resin beyond the line previously drawn is removed. The excess acrylic resin removed can be used to construct a handle for the special tray.

After complete polymerization of the acrylic resin, the tray is removed from the cast. Removal is facilitated by the presence of the tinfoil which will prevent the acrylic resin from sticking to the wax. Then the margins of the special tray can be finished, smoothed, and polished.

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## **Gingival retraction**

In cases when the finishing line is located below the level of the gum (subgingivally) or with the level of the gum, we need to do gingival retraction, which is a procedure by which the finishing line is temporarily exposed by enlarging the gingival sulcus so that we can take a good impression which involves the details of the end margin of the preparation that is located subgingivally.

### **Objectives of gingival retraction**

1. To create an access for the impression material to the area of the preparation that is located subgingivally.
2. To provide enough thickness of the impression material at the area of the finishing line to prevent tearing and distortion of the impression material.
3. To control the amount of fluid in the gingival sulcus (crevicular fluid) that will cause voids in the impression.



The objectives of gingival retraction: (1) to create an access, and (2) to provide enough thickness for the impression material at the area of the preparation that is located subgingivally.

### **Techniques of gingival retraction**

1. Mechanical.
2. Chemo-mechanical.
3. Gingival retraction paste (cordless technique).
4. Electrosurgical.
5. Laser.

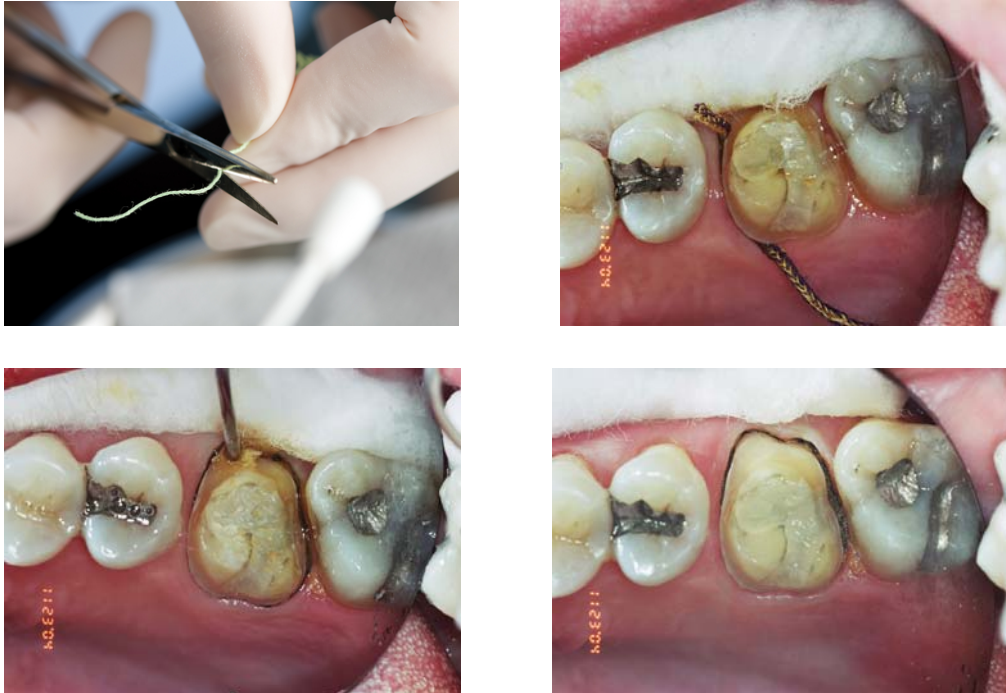
#### **1. Mechanical:**

In this technique, we apply pressure on the gingival to open the gingival sulcus. It might be done by either of the followings:

- Construction of a temporary crown with a slightly long margin leaving it in place for 24 hours, or
- Using a plane retraction cord (free of any medicament) which is the most common. The retraction cord is a special cord made of cotton which comes either

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plane (free of medicament), or is pre-impregnated with a medicament (usually a vasoconstrictor). Using a plane retraction cord is considered as a mechanical means only.



## **2. Chemo-mechanical:**

In this technique, we use a retraction cord that is pre-impregnated with a medicament, usually a vasoconstrictor (adrenaline, aluminum chloride, or ferric sulfate). By packing this cord with a plastic instrument (Ash No.6 or Ash No.49) in the gingival sulcus between the gingival tissue and the prepared tooth, the cord will mechanically push the gingiva away from the finishing line, and the combination of the chemical action of the medicament and the pressure exerted by the cord will cause a transient gingival ischemia. This will lead to shrinkage of the gingival tissue and control the fluid seepage from the gingival sulcus.

The retraction cord is left inside the gingival sulcus all around the tooth for 10 minutes. The working area should be kept dry during this period. Then the cord can be removed leaving the gingival tissue in an expanding state. This will provide a space to inject the impression material all around the tooth at the area of the finishing line by the use of an impression syringe.



**The retraction cords in place inside the gingival sulci of the prepared teeth.**

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### **3. Gingival retraction paste (Cordless technique):**

In most cases, gingival retraction cord is the most effective method for retracting tissue to the depth of the sulcus. Unfortunately, gingival retraction cord may injure the gingival sulcular epithelium and the gingival bleeding is difficult to control when packing a cord into the sulcus making impression difficult or impossible. Using a retraction cord requires proper tissue manipulation and is technique sensitive. For this reason a new class of gingival retraction materials has been introduced in the form of retraction paste like Expasyl (Aluminum chloride 15%) and Magic Foam Cord (Polyvinylsiloxane, addition type silicone elastomer).

The advantage of cordless retraction technique is providing a non-traumatic, non-invasive tissue management and excellent hemostasis in the gingival sulcus for fixed prosthodontic impressions.



**The Expasyl gingival retraction paste injected in place inside the gingival sulcus of the prepared tooth.**



**Magic Foam Cord gingival retraction paste injected in place inside the gingival sulcus of the prepared tooth.**

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#### **4. Electro-surgical:**

In this technique, an electro-surgical unit could be used to remove the gingival tissue from the area of the finishing line with the advantage of controlling the post-surgical hemorrhage. However, electrosurgery is contraindicated when there is gingival inflammation or periodontal disease. In this case, gingivectomy could be performed.



**The electro-surgical unit.**

**5. Laser :** For gingival retraction, Nd- YAG lasers are used.

#### ***Advantages of laser:***

1. Certain laser dentistry procedures do not require anesthesia.
2. Laser procedures minimize bleeding because the high-energy light beam aids in the clotting (coagulation) of exposed blood vessels, thus inhibiting blood loss.
3. Bacterial infections are minimized because the high-energy beam sterilizes the area being worked on.
4. Damage to surrounding tissue is minimized.
5. Wounds heal faster and tissues can be regenerated.

#### ***Disadvantages:***

1. Slow technique.
2. Expensive.



**The Nd-YAG laser unit used in dentistry.**



**Gingival retraction obtained by laser.**

## **Impression Techniques**

1. Single mix technique (monophase technique).
2. Double mix technique.
3. Putty-wash technique.

### **1. Single mix technique**

Most of the time, this technique is used when we have an impression material with single viscosity (such as the medium body consistency of polyether or addition silicone impression materials). This is because both materials are pseudoplastic materials and have the capacity for shear thinning. Pseudoplastic materials demonstrate a decreased viscosity when subjected to high shear rates such as occurs during mixing and syringing. When the medium viscosity material is forced through an impression syringe, the viscosity is reduced, whereas the viscosity of the same material residing in the tray is unaffected. In this manner, such materials can be used for syringing and for trays.

In this technique, after mixing the material, part of the material is loaded in the tray and the remaining part is loaded in the impression syringe. i.e., the same mix of the material is used to load the tray and the syringe. The impression material is injected from the impression syringe around the preparation area starting with the most critical parts such as the finishing line, then the prepared teeth and the other teeth in the dental arch. Then the special tray loaded with the impression material is inserted inside the patient's mouth and seated over the whole dental arch. After complete setting of the material, the impression tray is removed from the patient's mouth.

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## **2. Double mix technique**

This technique is usually used with materials that have two viscosities (heavy and light bodies). We mix the heavy body and the light body at the same time. The light body is loaded in the syringe, while the heavy body is loaded in the tray. We start to inject the light body on the dental arch starting with the prepared tooth, and then the tray loaded with the heavy body is inserted inside the patient's mouth and seated over the dental arch. The pressure created by the heavy body after seating of the tray will cause a direct flow of the light body into the details of the preparation including the finishing line.

## **3. Putty-wash technique**

This technique requires the use of a high viscosity material. We take an impression with the heavy body either before or after tooth preparation:

*-Before preparation:* we take a preoperative impression with the heavy body only prior to tooth preparation, and after complete setting of the heavy body we remove the impression tray from the patient's mouth and leave it aside. Then we do tooth preparation. After completion of tooth preparation, we mix the light body and load it in the syringe and inject it over the preparation area. Then we reseat the impression tray inside the patient's mouth and wait for the complete setting of the light body.

*-After preparation:* in this technique, after mixing of the heavy body and loading it in the tray, a spacer made of polyethylene is placed over the heavy body and the tray is inserted inside the patient's mouth. After complete setting of the heavy body, the tray is removed and the spacer is removed. The light body is then mixed and part of it is loaded in the syringe and the other part loaded in the tray over the heavy body. Then the light body is injected over the whole dental arch starting from the area of tooth preparation, and the tray is resealed inside the patient's mouth. After complete setting of the light body, the tray is removed from the patient's mouth.

This technique was developed for condensation silicones to minimize the effects of dimensional changes during polymerization. Most of the shrinkage during polymerization takes place in the putty material when the preliminary impression is made, confining final shrinkage to the thin wash portion of the impression.

## **Impression for post crown**

In case of post crown, we need to take an impression for the inside of the root canal. Most of the time, it is difficult to insert the impression material inside the tiny root canal, and even when it is inserted inside the canal it might tear during removal or become distorted during pouring of the impression. Therefore, the impression material needs a type of reinforcement. Such reinforcement could be obtained either by the use of a plastic post (impression post) or by using a stainless steel wire. After injection of the light body inside the root canal, the impression

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post or the stainless steel wire is inserted inside the canal. This will support the impression material and prevents its tearing or distortion during removal of the impression.



**An impression for the post crown with the plastic post (impression post) recording the inside of the canal.**

After removal of the impression from the patient's mouth, it should be inspected for the following:

1. The finishing line should be continuous all around the prepared tooth.
2. No air bubbles should be present at the area of tooth preparation.
3. The impression material should be attached well to the impression tray.

### **Disinfection of the impression**

Disinfection of the impression is a concern with respect to viral diseases such as hepatitis B, AIDS, and herpes simplex, because the viruses may be transferred to the gypsum models and present a risk to dental laboratory and operating personnel. The most common form of disinfection is spraying or immersion in disinfectants like 1% sodium hypochlorite or 2% potentiated glutaraldehyde solutions and iodophor.

### **Digital impression**

Digital impression represents the most recent development in Dentistry. The basics of digital impression start with capturing an image of the prepared teeth. This system uses an intra-oral camera (scanner) to capture the desired image (optical impression). This image is then electronically transferred to a manufacturing facility which fabricates a working, articulated model. On this model, a multitude of different restorations can be designed (crowns, bridges, inlays/onlays, and veneers) with a special computer software, which is connected with a milling machine. This procedure is termed CAD-CAM (Computer Aided Designing - Computer Aided Manufacturing).

### **Advantages of digital impression**

1. Digital impressions eliminate the uncomfortable experience of making a physical impression.



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2. The image on the monitor shows you if you have captured all the needed details before sending it to the lab.
  3. The accuracy of the mounting, bite registration, and stability of the dies create a model that allows the laboratory technician to fabricate a final restoration that has excellent marginal fit and incredibly accurate occlusion.
  4. The ability to see if proper occlusal reduction has been achieved.



**Chairside CAD-CAM unit.**



**Laboratory CAD-CAM unit.**

***Remember*** that you need the following requirements to obtain a good final impression:

1. Special tray.
2. Impression syringe.
3. Gingival retraction when needed.
4. Good understanding of the physical properties of the impression material which results in good handling of the material.
5. Dry field of operation. This is because all elastic impression materials, except hydrocolloids, are hydrophobic. i.e., they don't displace moisture; therefore, any moisture if present will result in voids or folds within the final impression.