Final Impression (Conventional & Digital Impression) in FPD

Conventional impression:

An impression is a negative likeness or an imprint of the form & relationship of teeth & surrounding oral tissues in crown and bridge.

Requirements for a good impression in crown and bridge prosthodontics:

1- It should be an exact duplication of the prepared tooth, including all of the preparation, and enough uncut tooth surface beyond the preparation to allow the dentist and technician to be certain of the location and configuration of the finish line.

2- Other teeth and tissue adjacent to the prepared tooth must be accurately reproduced to permit accurate articulation of the cast and to allow proper contouring of the restoration.

3- The impression of the preparation must be bubble free, which might result in inaccuracy especially in the area of the finish line.

Properties of material used for final impression in crowns and bridges:

1- It must be elastic after placement in the mouth because it must be withdrawn from the undercut regions that exist on the external tooth surface adjacent to the prepared tooth. A satisfactory impression must register some of these undercut surfaces without distortion or fracture.

2- The hydrophilicity of impression material, hydrophilic materials have a high affinity for moisture (low contact angle), provide good surface wetting, and allow for a high degree of surface detail. Hydrophobic impression materials have a low affinity for moisture (high contact angle), provide poor surface wetting, a lower degree of surface detail, and require strict moisture control.

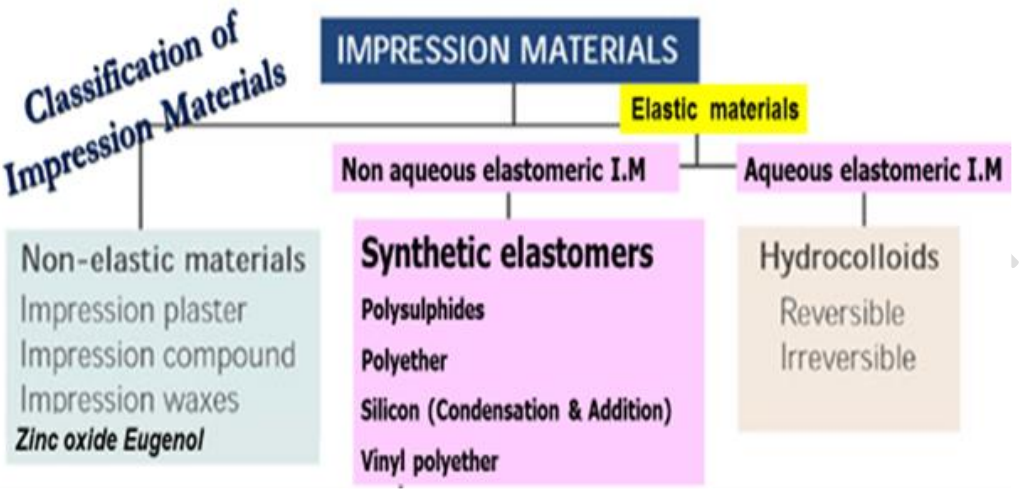
3- It must have adequate tear resistance (adequate strength to resist breaking or tearing on removal from the mouth).

4- It must have adequate dimensional stability, accuracy and reproduction of the details so that it is exact negative imprint of the prepared and unprepared teeth. The dimensional stability of the material, which is critical for accurate replication of the intraoral structures. **Dimensional changes** may occur due to (1) contraction from polymerization, (2) liberation of a by-product or accelerator component, (3) water absorption from a wet or humid environment, (4) a change in temperature.

5- It must have handling & setting properties that meet the clinical requirements.

6- It must be free of toxic or irritating components.

Classification of impression materials.



Non-aqueous elastomeric impression materials (Elastomers):

The elastomeric impression materials, set by chemical reaction, and usually supplied in different consistencies: **putty, heavy, medium & light bodies**. In crown and bridge work, we use the **light consistency** as **syringe material** to inject over the prepared teeth, remaining dental arch and try material (putty or heavy consistency) , while, **putty and heavy consistency** used as **tray material** to seat over the light consistency during final impression **procedure** . Whatever the consistency of the elastic material, it is supplied as two containers or tubes: base and catalyst.

1) Polysulfide impression material:

The material is supplied as a two-paste system (base and accelerator or catalyst), Available in a range of viscosities: **light body, medium or regular body, heavy body**.

Advantages:

1- Accurate if poured without delay (maximum storage time is 48 hours)
2- Long working time (multiple preparations cases)
3- Excellent tear resistance (high tensile strain before tearing)

Disadvantages:

1) Messy with objectionable odor
2) Long setting time
3) Shrinkage towards the tray (wider and shorter preparation)
- ✓ Evaporation of water as a setting by-product
- ✓ Continuous setting reaction after apparent setting time
- ✓ Unrecovered strain

Recommendations: Use a special tray with a 4 mm spacer, and remove impression in a single sift pull.

2) Polyether impression material:

Polyether impression material has excellent dimensional stability (upon polymerization mechanism unlike other elastomers. No volatile by-product), was **initially available in single "regular" viscosity (Impregum) A recently heavy light bodied system has been introduced**

Advantages

1) Fast setting time of less than 5 minutes
2) Has no setting reaction by-products
3) Dimensionally stable
4) Relatively hydrophilic
5) Adequate tear resistance a very good elastic property

Disadvantages:

1) If stored in high humidity conditions, they tend to swell due to water absorption.
2) Relatively rigid material when set, thus considerable force is required to remove the impression from the mouth and stone cast

3) Silicon impression material:

A. Condensation Silicon 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 8-9 minutes). As a result patient acceptance is better than polysulfide. It is also less affected by high operatory temperatures and humidity. Unfortunately, its dimensional stability is less than that of polysulfide although greater than that of reversible hydrocolloid. The material **available in all viscosities (Present in four viscosities ranging from very high (putty) to low).**

Advantages:

1) Accurate if regular or heavy body are cast within 6 hours of recording
2) Very good elastic properties, recovery of strain, adequate tear strength, neutral color and taste

Disadvantages:

1) poor wetting characteristics because it is extremely hydrophobic
2) Volatile by-products (ethyl alcohol) result in weight loss and shrinkage on storage

B. Addition Silicon impression material (vinyl polysiloxane silicon):

The main difference between the addition silicone and 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. The material is also supplied as a two-paste system (base and accelerator or catalyst). Setting time (5-9 minutes)The material **available viscosities are extra low, low, medium, heavy,and very heavy (putty) consistencies.** Impression pouring should be delay 1-2 hours (liberate hydrogen gas during polymerization, air bubbles will result)

Advantages:

1) The most dimensionally stable material (no by-product).
2) Accurate, high elastic properties, adequate tear resistance, nontoxic, neutral color and taste.

Disadvantages:

1) **Hydrophobic** thus strict moisture control is mandatory (some manufactures added surfactant (detergent) to make it more hydrophilic).
2) Surfactants improve surface wettability.
3) New hydrophilic addition silicone (Take 1, Kerr).
4) Sulfur contamination from **natural latex gloves inhibits the setting** of addition silicone
5) Touching the tooth with **latex gloves** before seating the impression can inhibit the setting of critical surface next to tooth

4) Vinyl polyether silicon

- It is formulation that combines the properties of addition silicones & polyethers.
- The material has dimensional properties similar to those of the addition silicones and polyethers.

Available Elastic Impression Materials

Material	Advantages	Disadvantages	Recommended Uses	Precautions
Irreversible hydrocolloid	Rapid setting Straightforward technique	Poor accuracy and surface detail	Diagnostic casts Not suitable for definitive casts	Must be poured immediately
Reversible hydrocolloid	Low cost Hydrophilic Long working time Low material cost No custom tray required	Low tear resistance Low stability Equipment needed	Multiple preparations Problems with moisture	Must be poured immediately For use only with stone
Polysulfide polymer	High tear resistance Easier to pour than other elastomers	Messy Unpleasant odor Long setting time Stability: only fair	Most impressions	Must be poured within 1 hr; takes 10 min to set
Condensation silicone	Pleasant to use Short setting time	Stability: only fair Hydrophobic Poor wetting	Most impressions	Must be poured immediately Care is needed to avoid bubbles during pouring
Addition silicone	Dimensional stability Pleasant to use Short setting time Automixing available	Hydrophobic Poor wetting Some materials release H_2 Hydrophilic formulations imbibe moisture	Most impressions	Pouring of some materials must be delayed Care is needed to avoid bubbles during pouring
Polyether	Dimensional stability Accuracy Short setting time Automixing available	Set material: very stiff Imbibition Short working time	Most impressions	Care is needed not to break teeth when separating cast

Rosenstiel SF, Land MF, Fujimoto J. Contemporary Fixed Prosthodontics-E-Book. Elsevier Health Sciences; 2015 Jul 28.

General factors that affect most of elastomeric rubber impression materials:

1) The rubber impression materials shrink during polymerization, so we must be sure about complete setting of the material before we remove it from the patient mouth.

2) The impression must be poured within one hour after removal.

3) The rubber impression material are most accurate when they are used in thin section and this will necessities the use of special tray when taking the impression to reduce the amount of the impression material so that we reduce the dimensional change that will occur.

4) The temperature and humidity reduce the setting time.

5) Alteration in the ratio of catalyst to base, will affect the setting time of the material.

For the **final impression** we need **special tray, special impression syringe** and the **impression material**. The special tray is made on the study cast.

Advantages of the study cast:

1) Diagnosis and treatment planning.
2) Construction of provisional restoration.
3) Construction of special tray.

Advantages of special tray:

1) It allows the use of impression material in minimum thickness to reduce 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 (without applying rotary movements).

Impression syringe:

Most of time it is made from clear plastic and should be available with different nozzle sizes, we need this syringe to carry light body impression material from the mixing slab and inject it, then, to the different areas of preparation.

Impression techniques:

According to number of steps & Viscosity of impression Materials used during impression registration we have the following techniques;

1. One step Impression technique

I. Monophase Single Viscosity
II. Heavy-Light

2. Two steps Impression technique

I. Spaced Putty Wash
II. Un Spaced Putty Wash

One step (monophase Single viscosity) technique.

Most of the time, we use this technique when we have impression material with single viscosity (medium body with polyether impression material) after we mix the material, part of the impression material is loaded in the syringe from the mixing slab, the other mixed part of the material is loaded into the tray. The impression material is injected from the syringe around the preparations starting with the most critical parts (pin holes, finishing lines then, the preparations and the remaining part of the dental arch then). The special tray loaded with impression material were then inserted inside the patient mouth and seat over the whole dental arch., wait for complete setting of the impression material then, it can be removed from the patient's mouth.

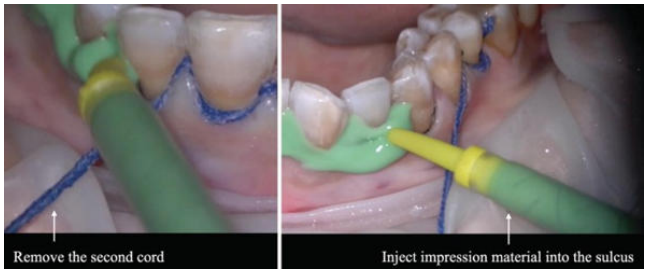




One step (heavy light or double mix) technique.

Usually used with materials that have two viscosities (heavy and light bodies), we mix the heavy and light bodies at the some time then, the light body is loaded in the syringe while, the heavy body is loaded in the special tray. We start to inject the light body on the dental arch starting with the prepared tooth then, the special tray with heavy body is inserted inside the patient's mouth and seated over the dental arch The pressure created by the heavy body will create

An intimate contact of light body with the prepared tooth surface. Make direct flow of the light body into details of the preparation.





Two steps putty wash technique.

This technique uses a high viscosity putty material; we start taking the impression with the putty body which could be before or after tooth preparation. Putty impression be:

1) **Un-spaced putty impression**; putty impression is recorded first after tooth preparation, then, after setting it relined with a thin layer or wash of light body impression material.
2) **Spaced putty impression** as for un-spaced except a space is created inside the putty impression for the wash (light body) layer.

Space could be created by:

I. Record with putty before teeth preparation

II. Record with putty after teeth preparation. Create space using **polyethylene spacer.**

III. Record with putty after teeth preparation. Create a space and escape channels using a scalpel.

Impression Procedure;

Step one:

Spaced putty wash technique:

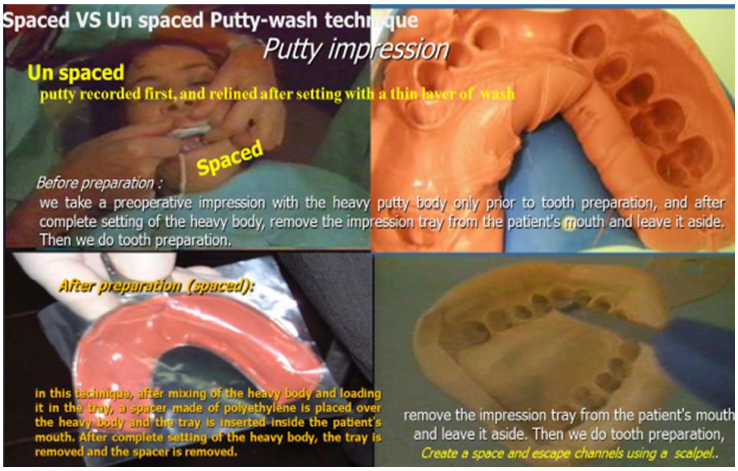
Putty impression of dental arch including the prepared tooth or teeth is firstly taken, space inside impression is created by one of following means:

1) **Before preparation**: we take a preoperative impression with the putty body only prior to tooth preparation, and after complete setting of the heavy body, remove the impression tray from the patient's mouth and leave it aside. Then we do tooth preparation.

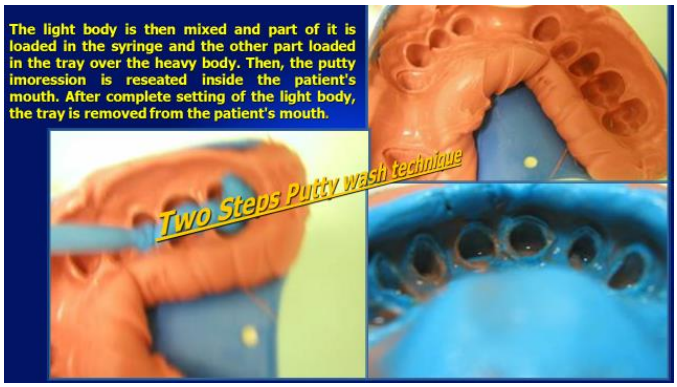
2) **After preparation: in this technique, after mixing of the putty body and loading it in the tray, a spacer made of polyethylene is placed over the heavy body and the tray is inserted inside the patient's mouth. After complete setting of the heavy body, the tray is removed and the spacer is removed.**

3) Or you can take putty impression after teeth preparation without spacer, then, after removal of the putty impression tray from the patient's mouth create a space and escape channels by removing from inside using a scalpel.

Un-spaced putty wash technique: as previous except that putty impression recorded after teeth preparation, no space is created her whether by using spacer or removal of surface layer of putty by scalpel, then, after complete setting, it is removed from the patient's mouth and left a side.

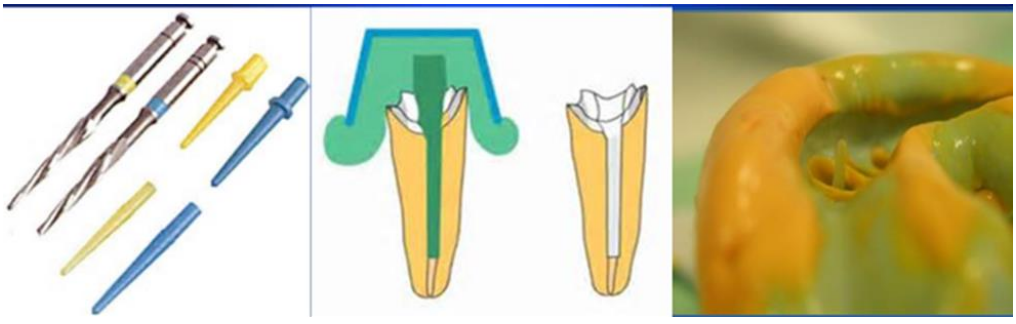


Step two: Whether spaced or un spaced putty wash technique, the next step is to mix the light body impression material, part of the mix loaded into the impression syringe while the remaining portion of the mix is place into the tray over the heavy body impression. The light body were then injected around the preparation and the whole dental arch, the heavy body impression was, then, reseat inside the patient's mouth over the injected light body impression material & wait for complete setting of the light body.



Impression for the post crown:

We need an impression for the root canal space, so, the impression material most of the time is difficult to be inserted inside the tiny canal and even when it fills the canal it might tear during removal or might be distorted during pouring with die stone (during construction of working cast). Therefore, So the impression material need a type of reinforcement, this can be obtained either by a plastic post or by stainless wire, which is inserted into the canal after injecting the light body inside the canal, this will support the impression material and prevents its tearing or distortion during removal of the impression, after the setting of the material, from the patient mouth

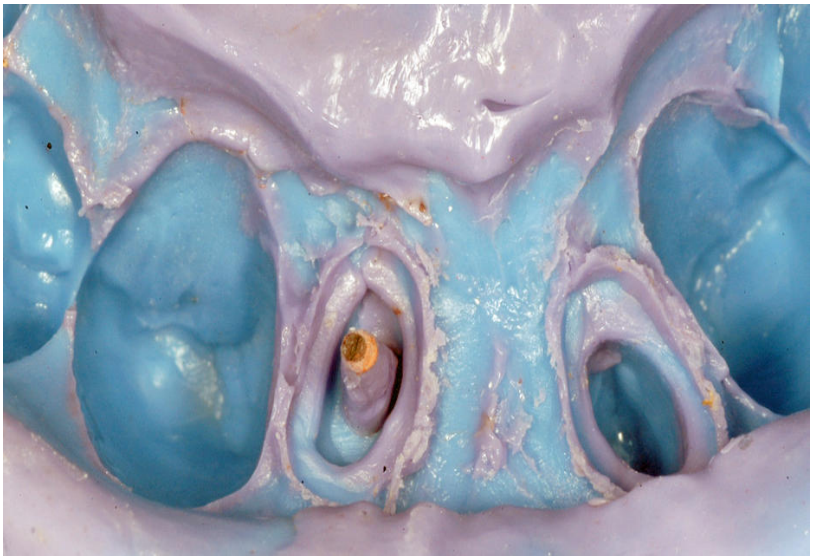


The impression should be inspected for the following:

1) Finishing line should be continuous from one side to another.
2) Presence of air bubble in the area of preparation.
3) Good attachment of the impression material to the tray.

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.



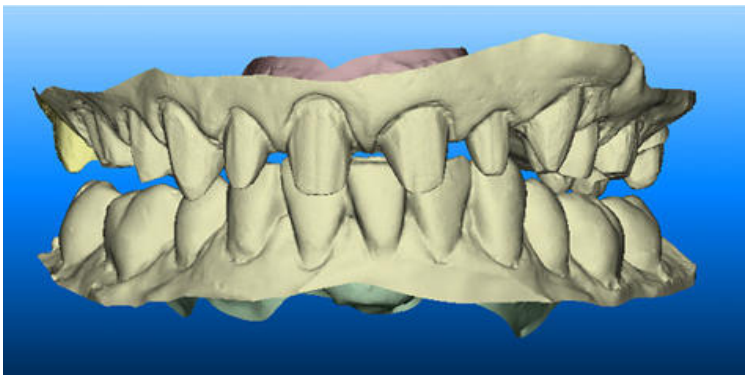
Digital impression

Digital impression represents the most recent development in Dentistry. It is procedure of recording the information related to the prepared teeth using scanning device that going to convert the shape of the prepared teeth into three dimensional (3-D) image display on the computer monitor. The operator were then designs a restoration shape using a special computer software, which is connected with a milling machine. This procedure is termed CAD-CAM (Computer Aided Designing - Computer Aided Manufacturing). The CAD/CAM system utilize a process chain consisting of scanning, designing and milling phases. The introduction of CAD/CAM systems in 1980s to dental field resolved a wide range of these limitations founding in the conventional impression techniques that required many steps; preparation of the abutment teeth, tray selection, impression making, impression disinfection, wax up and finally casting. As a result, several factors could effect on the accuracy of the traditional impression technique, furthermore, CAD CAM provide speed, storing the captured images with no distortion, 3D pre-visualization and checking the preparation and restoration before cementation.

Based on their production methods the Digital scanning can be divided Digital impression into:

1) **Indirect (extra oral) digital impression (Dental laboratory models):**

   The indirect systems scan a stone cast or die of the prepared tooth, in the dental lab (eg Cerec-in lab). Many of this system produce copings which require the dental technician to add esthetic porcelain for individualization and characterization of the restoration.



Disadvantages

- A cast need to be fabricated so, impression making is must, however master cast fabrication is time consuming and error prone method.
- Shadowing effect limits use of extra oral digitization method.

2) **Direct (intra oral) digital impression:**

Most widely and commercially used in Cerec System. This system can scan the tooth preparation intraorally using an intra-oral camera (scanner) to capture the desired image (optical impression). This image is then electronically transferred either to in office CAD CAM or in lab CAD CAM (a manufacturing facility) and by selecting appropriate materials, the restoration can be fabricated and seated within a single appointment. This procedure is termed CAD-CAM (Computer Aided Designing - Computer Aided Manufacturing).

The main advantages of Direct (intra oral) digital impression, It allows the dental care professional to take the data directly from the prepared tooth and there is no necessity of taking an impression and fabricating a cast, however, the only disadvantage of this technique that Tongue and saliva may pose some problems.

Type of Intra Oral Digital Scanner (Camera)

Based on data files created intra oral camera (scanner) might be;

1) **Open-system software**

Architecture files, typically termed STL files (standard file format also STL sometime referred as “Standard Tessellation Language” or “Standard Triangle Language”, are not dependent on the manufacturer, and can be used virtually in any design software to fabricate final restoration (Allow the adoption of the original digital data by CAD software and CAM devices from different companies)

2) **Closed-system software**

Architecture collects and manipulates data modules by the same manufacturer, offering laboratory owners security and a one-stop for resolving problems (All the steps are integrated into one system, and there is no interchangeability between different systems from other companies

Scanning procedure

After the tooth preparation is complete and the tissues are retracted to visualize the tooth margins, the tooth is dried and readied for scanning. Some scanning systems require the use of an oxide powder on the tooth to remove optical highlights from the surface of the preparation and to enhance the scan quality. Scanners use either a series of static images or a stream of video images to capture the geometry of the tooth preparation.

Advantages of digital impression

1. Digital impressions eliminate the uncomfortable experience of making a physical impression.
2. Evaluation of your preparation.
3. The image on the monitor shows you if you have captured all the needed details before sending it to the lab.

4. 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.
5. The ability to see if proper occlusal reduction has been achieved.
6. Recordkeeping. The digital impression can be stored and saved in PCs.
7. Disinfection of impressions is now a non-issue with a digital system.
8. Reducing Chairside time

Disadvantages of Digital impression.

1- The large size and the weight of the camera head and the device size.
2- Digital equipment's are complex and trained operator is required to operate and maintain the device.
3- High Cost.

Disinfection of Impressions

Set impressions are a source or reservoir for pathogens. They have been found to contain microorganisms – bacteria, fungi and viruses – following their removal from the patient's mouth, through transport to the laboratory and have also been shown to transmit microorganisms into stone and plaster while models are being poured. As such, they represent a risk for disease transmission to dental healthcare workers, transporting personnel, and laboratory personnel through indirect contact. Therefore, irrespective of the purpose, an appropriate infection prevention protocol must be followed before, during and after impression taking to avoid cross-contamination and the risk of disease transmission.

Disinfectants VS Antiseptics

Antiseptics, define as, Chemicals that destroy or inhibit the growth of microorganisms on living things (cell), while, **Disinfectants are,** Stronger Chemicals that destroy or inhibit the growth of microorganisms on object or non-living things. Accordingly, disinfection of impression is The process of destruction or removal of all pathogenic organisms, or organisms capable of giving rise to infection from impression.

Disinfectant protocol & Types of Impression Materials

Impression materials include the use non-elastic (such as compound) and elastic impression materials. The vast majority of procedures use elastic impression materials – aqueous hydrocolloids (typically alginate) and non-aqueous elastomeric materials including vinylpolysiloxanes (VPS or addition reaction silicones) (e.g., Aquasil), condensation reaction silicones (e.g., Xantopren), polysulfides (e.g., Permlastic) and polyethers (e.g., Impregum). The characteristics of these materials with respect to their hydrophilicity, the presence or absence of surfactant and their tolerance of immersion in water or other fluids are key elements in understanding disinfection protocols for impression materials. For example, VPS is hydrophilic and will absorb water and other liquids, changing its dimensions, and surfactant may also leach out affecting the wettability of the

impression; polyether is also hydrophilic and can leach; and alginates are sensitive to wet and dry environments.

An Overview of the Disinfection Procedure

Impression materials cannot tolerate heat and must therefore be chemically treated, as with heat-sensitive instruments (except handpieces). However, while instruments can be cold sterilized by immersing them in a hospital-level disinfectant for several hours (the number depending on the chemical), impression materials are sensitive to long-term immersion and are therefore disinfected, as opposed to cold-sterilized which takes longer.

Disinfectant materials

- **Glutaraldehyde / Cidex (2% alkaline NaHCO3): -**

It is a high level disinfectant. Especially active against tubercle bacilli, fungi and viruses. Less toxic than formaldehyde. Exposure time: > 10hrs.

- **Phenols:**

Acts by cell membrane damage thus releasing cell contents and causing lysis**.**Eg. Cresol (LYSOL), chlorhexidine (SAVLON), chloroxylenol (DETTOL) & hexachlorophen. Phenol is commonly found in mouthwashes, scrub soaps and surface disinfectants. Low efficiency disinfectant

- **Halogens:**

Bleaching powder or hypochlorite solution mostly used disinfectant for HIV infected material. In concentration of 0.05 or 0.5% used for surface material and instruments disinfection. Should be prepared daily because of instability of sodium hypochlorite solution. Active against bacteria, spores, fungi and viruses (HB, HIV)

- **Iodophors & Iodine**

Active against bacteria, spores & some viruses & fungi. (7.5% Povidone+iodine= Betadine The manufacturer's directions for disinfection must be followed.

Advantages and Disadvantages of disinfectant materials

MATERIAL	ADVANTAGES	DISADVANTAGES
CHLORINES	➢ Rapid action ➢ Broad spectrum ➢ Economical	➢ Prepare solution daily ➢ Diminished activity by organic matter ➢ Corrosive
IODOPHORES	➢ Broad spectrum ➢ Few reactions ➢ Residual biocidal activity ➢ Few reactions	❖ Unstable at high temperatures ❖ Dilution and contact time critical ❖ Discoluration ❖ Prepare solution daily SYNTHETIC
PHENOLS	➢ Rapid action Broad spectrum ➢ Compatible with most metal	➢ Degrades certain type of plastic over time ➢ Difficult to rinse ➢ Film accumulation ➢ Alchol base products are fair to poor cleaning ability

The general steps in the disinfection procedure are as follows:

- Blood and bioburden must first be cleaned off the impression prior to disinfection
- Cleaning should be performed immediately after taking the impression, before blood and bioburden has a chance to dry onto the impression material. While instruments can be pre-soaked to loosen debris, impression materials have limited tolerance of immersion in liquids and this should therefore be minimized and controlled
- The impression material is next disinfected using any of disinfectant material
- After disinfecting the impression, it must be rinsed under running water before being further processed or sent to the laboratory. Failure to properly rinse the disinfectant off the impression can result in a substandard model due to incorporation of residual disinfectant into the mixed stone or plaster

METHODS OF DISINFECTING IMPRESSIONS

The required exposure time for a disinfectant is an important element in its selection for disinfecting impressions. The impression is soaked by either **spraying or immersing** the impression material. Both techniques have been found to be effective in controlling bacterial contamination and preventing cross-contamination. Immersing a given impression material in disinfecting solutions and other fluids for too long a period risks dimensional & surface changes which affects the accuracies in dies and models. Whether **Disinfecting Solution or Sprays,** the manufacturer's recommendations must be followed. After removal from mouth the impression is immediately rinsed with tap water & dried with air syringe. Suitable chemicals should be used for disinfection such as glutaraldehyde solution or iodophor sprays. Because of it tendency to distort & absorb moisture, polyether & hydrophilic addition silicon impression materials should be sprayed and stored in a plastic bag rather than submerge and soaked in a glutaraldehyde solution.

Recommended Disinfection Method by Impression Material

Disinfection	Irreversible* Hydrocolloid	Reversible* Hydrocolloid	Polysulfide	Silicones	Polyether†
Glutaraldehyde 2% (10-minute soak time)	Not recommended	Not recommended	Yes	Yes	No
Iodophors (1:213 dilution)	Yes	Yes	Yes	Yes	No
Chlorine compounds (1:10 dilution of commercial bleach)	Yes	Yes	Yes	Yes	Yes
Complex phenolics	Not recommended	Limited date	Yes	Yes	No
Phenolic glutaraldehydes	Not recommended	Yes	Yes	Yes	No

*Immersion time should be minimized. Dip in glutaraldehyde, rinse in sterile water, dip again, and delay pouring for 10 minutes while maintaining a humid environment. Alternatively, spray with sodium hypochlorite, rinse, and respray with a similar 10-minute delay before pouring.

†Imbibition distortion results from prolonged immersion. For 1:10 hypochlorite or chlorine dioxide: spray, rinse, repeat, spray again, and delay pouring for approximately 10 minutes.