Dental impression: A replica whether for a tooth, a partially edentulous patient, or an edentulous patient.

Edentulous patient: A patient who has lost all of their teeth.

Partially dentate patient: A patient who lost part of their teeth.

Dentate patient: A patient who has a default complement of their teeth.

Whether it is being done on an edentulous, partially edentulous, or a person with teeth, its principles are the same.

Impression trays are used as a device to hold the impression material and to bring it into the patient’s mouth.



**Impression materials:**

Neocolloid is an example of alginate. You place it in the patient’s mouth, you get an impression, then we pour this impression using gypsum products and we get a dental model. This dental model is then taken to a lab.

The dental model is important as it is the only method of communication between the clinic and the lab. For example if you want to put a crown for someone, you send the dental model to the lab, then receive the crown.

It’s important to learn how to use impressions for two reasons:

1. You want to provide your patient with the best quality of work.
2. You want to look confident in front of your patient, repeating the impression several times in front of the patient is not good for your image.

The key to using dental materials is knowing their properties, and when to use which specific material for which specific task.

**General requirements for dental impression materials:**

1. **Accuracy**: The most important one. You want the replica of your patient’s mouth to be as accurate as possible when you transfer it to the lab, regardless of the task you are doing.

**Factors which affect accuracy:**

Viscosity: A material with a lower viscosity would reach beyond the ridges of a tooth, thus resulting in a higher accuracy.

A viscous material would require a lot of applied pressure in order for it to be seated properly. This would result in the loss of some of the details.

The lower the viscosity, the better the details production. However, as viscosity decreases, the tear resistance decreases as well. (It becomes more prone to tearing). We can overcome this disadvantage by adding specific elements.

1. **Interaction with saliva:** A hydrophobic material would not be as accurate as a hydrophilic material. Therefore we always try to use a hydrophilic material.
2. **Wettability (wetting ability):** The ability of a material to maintain contact with a solid surface. Relies heavily on the contact angle. As the contact angle decreases, the wettability increases, therefore we would like the contact angle to be as low as possible.
3. **Dimensional change upon setting:** We need the dimensions of the tooth to be preserved exactly the same. However there is no impression material that would give Zero dimensional change.
4. **Thermal changes:** There is a difference of about 10 – 15 degrees between the patient’s mouth and the room’s temperature. The impression material is mixed in the tray at about 20 degrees and then it is placed in the patient’s mouth which is around 37 degrees, then it is removed and again it returns to 20 degrees. The material should be able to withstand those temperature changes.
5. **Adhesion to the tray:**
6. Mechanical retention: the tray has perforations which allow for mechanical adhesion between the material and the tray.
7. Each impression material has its own adhesive which is sprayed or painted on the tray, and then the impression material is placed in the tray.

If this is not done, the impression material will separate from the tray and we will have to redo it.

It might separate just a little, if unnoticed; this would result in an inaccurate impression.

1. Adequate elastic properties: Rigidity and tear resistance.

The impression material needs to be elastic because the teeth are full of ridges and contours. The areas below the contours are called under-cuts. (Under-cuts: any part of the tooth beyond the height of contour.)

When we place a dental material in a patient’s mouth it is soft, then we wait until it sets. If the material is rigid, when it sets, it cannot be removed from the patient’s mouth. (The material gets stuck in the under-cuts). An elastic material would not get stuck in the under-cuts.

1. **Dimensional stability:** An impression material would rarely be poured in the clinic; it is usually taken to a lab. This takes some time. In the lab, it might be left over night. If the material is not dimensionally stable, the impression would be lost.
2. **Ease of handling:** We definitely want something we can easily handle.

**10- Low cost.**

 **11- Good taste and smell.**

**Classification of impression materials:**

**“Elastic materials” and “Non elastic materials (Rigid)”**

|  |  |
| --- | --- |
| **Elastic** | **Non elastic (Rigid)** |
| Hydrocolloids | Zinc Oxide eugenol |
| Synthetic Elastomers | Impression plaster |
|  | Impression compound |
|  | Impression waxes |

**Elastic materials:**

**Hydrocolloids:** can be divided into two main types: reversible and irreversible hydrocolloids.

Hydrocolloid: Hydro 🡪 mixed with water. Colloid 🡪 gel consistency

When we mix it, it turns into gel consistency.

In the reversible type, it can go back and forth between the two phases (gel and sol (solution) phase). When heated, it goes to the gel phase, when cooled, it returns to the sol phase. The more common name for this is “agar-agar”. (This is a physical reaction).

The irreversible is also called “alginate”, it just goes from the sol to the gel phase. This is not a physical reaction, it is a chemical one.

**Alginate (irreversible)**:

**Disadvantages:**

Low tear resistance.

Very poor dimensional stability. Its main constituent is water that’ll evaporate if the surrounding atmosphere is hotter than the material; the material will shrink.

This is known as imbibition and syneresis.

Syneresis: Evaporation of the liquid from the gel.

Imbibitions: Water absorption.

If the impression **shrinks**, the model obtained from the impression will be **larger** than the original tooth form.

Alginate impressions must be poured within 10 minutes. This means that it must be poured in it clinic unless there is a lab nearby.

**Advantages:**

1. Good surface details
2. Hydrophilic: Gives a good impression with the presence of saliva
3. Cheap: 10 times the cost difference between alginate and other materials

Viscoelastic: When you pull it out, you expect some distortion. Therefore it must be taken out in one quick snap. Do not move backward/forward and right/left. This will put more distortion in the impression material.

All materials we will talk about are accurate and satisfy their properties only when used in the proper thickness. For the alginate, this thickness is 3 – 5 mm.

Each patient has a different jaw size, therefore we have multiple tray sizes and before using one, we will try if it fits well. When testing this, leave 3 to 5 mm for the alginate.

If thickness is less than 3 – 5 mm, the tear would increase.

If thickness is more than that, it will also tear away from the impression.

**Agar-agar (reversible):**

It is extracted from one type of algae. It is a complex polysaccharide. It is a naturally occurring material. The main part of it is extracted from the red algae or sea weed. In addition to it, we add borax, potassium sulfate, and 85% water.

We add borax so that it would act as a body, since the original material is very soft. However, the addition of borax retards the setting time and setting reaction (might not set properly). Gypsum materials originally have a setting time of about 45 minutes to an hour. We counteract the effect of borax using potassium sulfate.

Usually it comes in tubes, and it is pushed out directly into the tray. When we heat it, it turns to a liquid. When we cool it, it turns to a gel.

The trays used for agar-agar are special, since we need to cool the material while it is still in the patient’s mouth. The tray has a tube coming out of it; this tube is connected to cooling water. The water enters the tube and circulates around the tray, thus cooling the material (turns into gel).

Since we can cool and heat the material several times, we could reuse it multiple times even for different patients. However, we do NOT do that since it is not hygienic. (Cross infection control)

It is mainly used in the lab since it gives great surface details. It is used to make copies of the models.

It is also used with partial dentures.

**Alginate:**

Initially it has a low viscosity. Once placed in the patient’s mouth, it turns into a gel phase. What controls the speed of the reaction is the temperature of the water used to mix the material. Cold water has a slow reaction speed.

Has a specific measurement for water and powder that must be followed.

The only control we have over the setting time is the water’s temperature.

Adding more water might give us more time to handle the material, however it also ruins the properties of the material.

**Powder’s main components:**

Sodium/potassium salt of algenic acid – main reactive ingredient.

Gypsum – Calcuim Dihydrate – used as a source for calcium ions. Calcium ions react with the sodium/potassium salt giving sodium/potassium alginate (This gives us the gel phase).

Diatomaceous earth – replaces borax used in agar-agar (used as filler).

Trisodium Phosphate – increases the reaction time.

 As Trisodium Phosphate concentration increases, the reaction time increases.

Fast set materials – less Trisodium Phosphate.

**Synthetic Elastomers:** Polysulfide

 Polyether

 Condensation silicon

 Addition silicon

Started in the 1950s. Its main purpose was to overcome the poor dimensional stability of Hydrocolloids and the inadequate tear resistance.

For every type, we can find different consistencies.

We have a light body, medium body, and a heavy body. Each has its own use.

There are three different ways of mixing them.

1- Old fashioned: Put two equal lengths of paste and mix them by hand.

2- Static auto-mixing: Like a gun, two cartilages release their contents and they are automatically mixed once a trigger is pressed. It is directly injected into the tray. This is commonly used now.

3- Dynamic mechanical mixing: A huge cartilage. Once a button is pressed, the contents are automatically mixed and then loaded in the tray.

Theses mixing techniques are common to all Synthetic Elastomers.

**Polysulfide:** Was not originally developed for dentistry. It is biocompatible.

First Synthetic Elastomer used for dentistry.

Available in different viscosities (light – medium – heavy).

Unpopular nowadays because we have better materials.

It comes in two paste-like tubes. You just inject equal amount and mix them.

**Disadvantages:**

-It contains Sulfur, which smells and tastes bad.

-Long setting time (10 minutes).

-If Lead Dioxide stains your cloth, it doesn’t come out.

-Shrinkage due to loss of byproduct (water).

**Advantages:**

-Has really good dimensional stability

-It has a great surface detail reproduction.

-Long working time.

-Excellent tear resistance.

It consists of a base and a catalyst.

Base – Polysulfide polymer 80 – 85%

Titanium Dioxide / Zinc Sulfate / Copper Carbonate / Silica

Catalyst – Lead Dioxide (main part) \*we have different shades of Polysulfide; they are affected by Lead Dioxide. As its concentration increases, the darker the color becomes.

Dibutyl phthalate – acts as the filler.

dioctyl phthalate – used instead of borax

It goes through a chemical reaction. (Condensation reaction – water is a byproduct)

Special considerations: not very stable on the long term (up to 48 hours which is still much more than alginate). Must be poured within 48 hours otherwise it will lose some dimensional stability due to loss of water as a byproduct.

**Polyether (1970’s):**

 -First Synthetic Elastomer specifically used for dentistry.

-Addition reaction - no by product thus more stable than poly sulfide.

-Acid base reaction.

\*Here the tubes are not the same size (the smaller is the catalyst)

Base: Amine terminated prepolymer (main constituent). Addition reaction gives us a long chain polymer. Cross linking occurs on the prepolymer.

Silica – filler.

Phthalate – plasticizer

Catalyst: The smaller tube. Ester derivative of aromatic sulfonic acid

Initiates the cross linking.

**Advantages:**

-Hydrophilic (more than polysulfide)

-Good tear resistance

-Faster setting time than polysulfide

**Disadvantages:**

-Very rigid upon setting.

-Since it is hydrophilic, it might absorb humidity from the atmosphere which would cause swelling. (Must be poured within 48 hours)

\*Should not be used on patients with periodontal disease since their teeth have some mobility. It might extract the tooth with it. It could also get stuck between the papillae of the teeth; it would then extract some of the tooth with it.

