

PROSTHODONTICS

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المرحلة الرابعة

Impression Materials and Procedure for R.P.D

Most impression materials used in prosthetic dentistry could be classified as follows:

A-Rigid materials:

- 1- Impression plaster.
- 2- Metallic oxide paste.

B- Thermoplastic materials:

- 1- Modeling plastic.
- 2- Impression wax and resin.

C- Elastic materials:

1- Hydrocolloid:

- a- Reversible hydrocolloid (Agar-Agar).
- b- Irreversible hydrocolloid (Alginate).

2- Elastomers:

- a- Mercaptan rubber base impression material.
- b- Silicon impression material:
 - 1) Condensation reaction silicon.
 - 2) Addition reaction silicon.
- c- Polyether impression.

A- Rigid Materials:

Those that get to a rigid consistency. They cannot be removed from the mouth without fracture in spite of the fact that these materials may be capable of recording tooth and tissue details accurately.

1- Impression plaster.

This material with introduction of elastic impression material has been completely replaced by elastic impression material.

2- Metallic oxide paste.

It is usually some form of zinc oxide eugenol combination, those are not used as primary impression materials and should not be used for impression that include the remaining natural teeth, they are also not to be used in stock impression tray.

Metallic oxide paste can be used as:

- secondary impression material for complete denture and for extension base edentulous ridge areas of RPD.
- it can be used with custom acrylic impression tray (special tray) which has been properly designed and attached to the partial denture framework.
- Also it can be used as impression for relining distal extension denture bases.

B- Thermoplastic materials: are those that become plastic at higher temperature and they resume their original form when temperature has been lowered. They cannot record minute details accurately because they undergo distortion during withdrawal from tooth and / or tissue undercuts.

1- Modeling plastic:

The most commonly used modeling plastic is the red material in cake form and the green stick form for use in border molding impression material. It is generally used only as a mean of building up the underside of the special tray before recording the tissue with some secondary impression material.

2-impression wax and resin:

It is used in recording the edentulous area; also, it may be used to correct the borders of impression made of more rigid materials

c- Elastic materials: are those that remain in an elastic flexible state after they have been removed from the mouth. They are the only ones that can be

withdrawn from tooth and tissue undercuts without permanent distortion, forming the most suitable impression materials for recording the irregular contours of oral both hard and soft tissues. The elastic impression materials are most generally used for making impressions of partially edentulous arches, for cases of immediate dentures, fixed partial dentures, and crowns, and that is when tooth and tissue undercuts and surface details must be recorded with accuracy, where the introduction of hydrocolloids as impression materials was a long step forward in dentistry. These materials (elastic) permit the making of a one piece impression which does not require the use of a separating medium and an extremely accurate material if properly handled following instructions.

1- Hydrocolloid:

a- Reversible Hydrocolloid: (Agar-Agar)

- 1) It is fluid at high temperature and gel on reduction in temperature.
- 2) It is used as impression material for fixed restoration.
- 3) It demonstrates acceptable accuracy when properly used.
- 4) The border control of impression made with these materials is difficult.

b- Irreversible Hydrocolloid (alginate):

- 1) It is used for making diagnostic cast, orthodontic cast and master cast for RPD.
- 2) This material has low strength provide less surface details than other materials.
- 3) Dimensionally unstable, it can be used in the presence of moisture and it is hydrophilic.
- 4) Has good taste and odor and not toxic.

2- Elastomers:

a- Mercaptan rubber base impression materials

- 1) It can be used for RPD impression and especially used for altered cast impression.
- 2) The accuracy of Mercaptan rubber base impression exceeds that of properly made irreversible hydrocolloid impression, beside that the impression with the hydrocolloid impression materials need certain precaution that must be taken to avoid distortion of the impression.
- 3) Other advantages over hydrocolloid impression materials are that the surface of an artificial stone poured against them is of a smoother and harder than one poured against hydrocolloid material.

The difference between the two types of hydrocolloids (Agar and alginate) is:

A) Agar changes from the gel to a solution by application of heat. This could be reversed or converted to gel form by a reduction in temperature, such a physical change is reversible.

B) Alginate become a gel through a chemical reaction as a result of mixing the alginate powder with water, here such a physical change is irreversible.

Disadvantages of Agar:

- 1- It must be introduced into the mouth while warm enough to become a solution to be converted into an elastic gel on cooling. Thus there's an ever-present danger of burring the oral or mouth tissues.
- 2- It requires warming and tempering equipment, thermo-plastically controlled necessating the use of water –jacketed impression trays for cooling.

Note: All hydrocolloids are dimensionally stable for only a brief period after removal from the mouth.

Alginate impression material:

The present alginate (irreversible hydrocolloid impression material) was developed as a substitute for the agar impression material when its supply became scarce during World War II. This material is based on a natural substance extracted from certain brown seaweed. The substance is called (alginic acid).The general use of alginate far exceeds that of other impression materials available today. The principal factors responsible for the success of this type of impression material are that: it is easy to manipulate, comfortable for the patient and relatively inexpensive since it does not require elaborate equipment. Most alginate impression materials are not capable of reproducing the finer details that are observed in impressions with other elastomeric impression materials. Nevertheless, alginate

materials are sufficiently accurate that they can be used for making impressions for removable partial dentures.

Biocompatibility:

No known chemical or allergic reactions are associated with hydrocolloid impressions. But inhaling fine airborne particles from alginate impression material can cause silicosis and pulmonary hypersensitivity, therefore dustless alginate is preferred to minimize this risk.

Composition:

- 1- **Soluble alginates:** The chief active ingredient of the alginate impression material is one of the soluble alginates such as sodium, potassium or triethanolamine alginate. When the soluble alginates are mixed with water, they form a solution quite readily.
- 2- **Diatomaceous earth:** is to act as a filler to increase the strength and stiffness of the alginate gel, to produce a smooth texture, and to ensure the formation of a firm gel surface that is not tacky. It also aids in forming the solution by dispersing the alginate powder particles in the water.
- 3- **Zinc oxide:** also acts as filler and has some influence on the physical properties and setting time of the gel.
- 4- **Calcium sulfate dihydrate:** is generally used as the reactor.
- 5- **Sodium phosphate:** is added as a retarder to control the setting time.
- 6- **Fluoride:** such as potassium titanium fluoride, is added as an accelerator for the setting of the stone to be poured in the impression to ensure a hard and dense cast surface.

Formula for the powder component of an alginate impression material:

Component	Function	Weight percentage
Potassium alginate	Soluble alginate	15
Diatomaceous earth	Filler particles	60
Zinc oxide	Filler particles	4
Calcium sulfate dihydrate	Reactor	16
Sodium phosphate	Retarder	2
Potassium titanium fluoride	Accelerator	3

Step by step procedure for Making a Hydrocolloid Impression:

- 1) Select a suitable, sterilized and sanitary rim-lock or perforated impression tray that is large enough to provide 4-5mm border thickness of the impression materials.
- 2) Build up the palatal portion of the maxillary or upper tray with wax or modeling compound thus ensuring an even distribution of the impression material from slumping away from the palatal surfaces. If gelation occurs near to the tissues while the deeper portions are still fluid, a distorted impression of the palate may result which cannot be detected in the finished impression, this may result in the major connector of finished casting not being in contact with the underlying tissues, a maxillary tray has got to be extended posterior to include the tuberosities and the vibrating line region of the palate.
- 3) The lingual flange of the mandibular trays has got to be lengthened with wax in the retromylohyoid area or to be extended posteriorly, also wax

may need to be added inside the dislolingual flange to prevent the tissues of the floor of the mouth from rising inside the tray.

- 4) The patient should be placed in an upright position with the involved arch nearly parallel to the floor.
- 5) The first step of manipulation is to prepare a proper mixture of water and powder (alginate), the measured amount of water about (70 F) should be added into a clean, dry rubber mixing bowl of about (600mml) capacity.
- 6) The measured powder is sifted into the premeasured water that has already been poured into the rubber bowl. The powder is incorporated into the water by carefully mixing with a metal or plastic spatula that is sufficiently flexible to adapt well to the wall of the mixing bowl. The water is added first to wet the mixing bowl and to ensure complete wetting of powder particles. If the powder is placed first in the mixing bowl, penetration of the water to the bottom of the bowl is inhibited and greater mixing time may be required to ensure a homogeneous mixture. Care should be taken to avoid incorporating air into the mixture. A vigorous figure-8 motion is best, with the mixture being swiped or stropped against the sides of the rubber –mixing bowl with intermittent rotations (180°) of the spatula to press out air bubbles. All of the powder must be dissolved. Such a procedure (mixing time) should be accomplished within 45 sec to 1min. The result should be a smooth, creamy mixture that does not readily drip off the spatula when it is raised from the bowl. Clean equipment is important because many of the problems and related failures are attributed to dirty or contaminated mixing or handling devices. Contaminants such as small amounts of

gypsum left in the bowl from a previous mixture of plaster or stone can accelerate the set. It is best to use separate bowls for mixing alginate and stone.

Controlling the setting time: In the clinical setting, it is tempting to alter the setting time by changing the water/powder ratio or the mixing time. The clinician, however, can safely influence the setting time by altering the temperature of the water. It is evident that the higher the temperature, the shorter is the setting time (1 min reduction in setting time occurs for each 10° C of temperature increase). The temperature of the mixing water should be controlled carefully within a degree or two of a standard temperature (usually 20° C) so that a constant and reliable setting time can be obtained. In hot weather, special precautions should be taken to provide cool water for mixing so that premature gelation does not occur. It may even be necessary to precool the mixing bowl and spatula, especially when small amounts of impression material are to be mixed. The patient should rinse his mouth with cool water to dominate the excess saliva while the impression material is being mixed and loaded into the tray.

- 7) During placement of the material in the tray, try to avoid any entrapping of air. The first layer of the material should lock into the tray perforations thus preventing any possible dislodgement during gelation.
- 8) Quickly rub some of the remaining impression material after loading the tray into some critical areas with your finger such as the rest preparation, abutment teeth, the distolingual surface near the retromolar pad in the

lower arch, when an upper impression is being made, placing some of this materials in the highest aspect of the palate and over the rugae area.

- 9) Using a mouth mirror or with your index finger try to retract the cheek away from your side, as the tray is being rotated into the mouth from near side.
- 10) Seating the tray should be from the side away from you first, next on the anterior area, during which the lip is being retracted and then on the near side making sure that the lip is dropping naturally over the tray.
- 11) Don't ever seat the tray too deeply thus leaving a room for the material thickness that is necessary for the occlusal and incisal surfaces.
- 12) Try to hold the tray without any movement, immobile and stable for about 3min with light finger pressure over the left or right premolar areas, here the patient should be introduced an avoiding any movement during gelation, thus avoiding internal stresses which may arise in the finished impression, never let the patient or the assistant to hold the tray instead of you in position; some movement of the tray is inevitable during the transfer and at the critical time of gelation, movement will Produce an inaccurate impression. Don't remove the impression from the mouth till the impression material has completely set. The alginate impression should not be removed from the mouth for at least 3 minutes after gelation has occurred, it has been shown that if the impression is held for 6 to7 minutes after gelation rather than 3 minutes, significant distortion may result.
- 13) Releasing the surface tension, to remove the impression with a quick action in the line along the long access of the teeth, thus avoiding tearing

or any other distortion. Usually the alginate impression does not adhere to the oral tissues as strongly as do some of the non-aqueous elastomers, so it is easier to remove the alginate impression rapidly. However, it is always best to avoid torqueing or twisting the impression in an effort to remove it quickly. Specifically, the handle should be used minimally during breaking of the air seal (suction) or removing the tray from the teeth.

14) Rinse the impression free of saliva with slurry water, after the impression is rinsed thoroughly, the disinfectant can be sprayed liberally on the exposed surface. The impression is then wrapped immediately in a disinfectant-soaked paper towel and placed in a sealed plastic bag for 10 minute. Finally the wrapped impression is removed from the bag, unwrapped, rinsed, and shaken to remove excess water. The impression is then poured with the stone of choice. Since the alginate impression must be poured within a short time after removal from the mouth, the disinfection procedure should be relatively rapid to prevent dimensional change. A cast should be poured immediately into the hydrocolloid impression to avoid dimensional changes and syneresis when pouring is delayed for one reason or another, where it should not exceed 15 minutes.

Note: Alginate impression materials are hydrophilic, so moist tissue surfaces are not a problem.

Precautions to be observed in the handling of hydrocolloids:

- 1- An impression should not be exposed to air, because these materials rapidly lose water which will result in shrinkage and dimensional changes.

- 2- Such impression should not be immersed in water because they will imbibe water with an accompanying swelling and dimensional changes.
- 3- Impressions should be placed in a humid atmosphere or wrapped with a damp cloth until pouring into a cast thus preventing dehydration; this pouring should be within 15 min after removal from the mouth.
- 4- The exudates from hydrocolloid, has got a retarding effect on the chemical reaction of gypsum products resulting sometimes in a chalky cast surface. This can be prevented by:
 - A) Pouring the cast immediately.
 - B) First immersing the impression in a solution of accelerator (accelerator for gypsum product setting) such as 2% solution of potassium sulfate (K_2SO_4) for 5-10 min, before the cast is poured.

Step by step Procedure for Making a Stone Cast from a Hydrocolloid Impression:

- 1- The measured dental stone at hand, pour the measure of water into a mixing bowl and adding the measure of stone, spatulate thoroughly for 1min; where mechanical spatulation is preferred.
- 2- The hydrocolloid impression material may require a (fixing solution), such a procedure should be made before pouring the cast, remove the damp cloth or the impression from the fixing solution, gently shake-out any moisture, holding the impression over the vibrator with the impression side up, and only the handle of the tray contacting the vibrator,

the impression material may not be placed in contact with the vibrator because of possible distortion.

- 3- With small spatula add the material to the distal area away from you. Allow this material to be vibrated around the arch from tooth to tooth towards the anterior part of the impression; continue to add more material, thus avoiding any air entrapment. The weight of the casting material causing any excess water to be pushed around the arch and to be expelled ultimately at the opposite end of the impression, discard this fluid material, after filling the impression of all the teeth, continue to add stone in larger portions until impression is completely filled.
- 4- The filled impression should be placed on a support jig where the base of the cast is to be completed with the same stone mix. The base should be 16-18mm at its thinnest portion and should be extended beyond the borders of the impression so as to record buccal, labial and lingual borders in the finished cast.
- 5- As soon as the cast has been formed with sufficient body, trim the gross excess (from the sides of the cast with a wet paper towel) until the initial set of the stone has taken place, thus the impression is prevented from losing water through evaporation which may in turn deprive the cast material of sufficient water cast for crystallization. Chalky cast surface around the teeth are often the result of the hydrocolloids acting as a sponge and robbing the cast material of its necessary water for crystallization.

- 6- After the cast and impression have been placed in the humid atmosphere and for about 30min; separate the impression from the cast. These 30 min, are just enough for the initial setting.
- 7- Clean the impression immediately while the impression material is still elastic.
- 8- The trimming of the cast should be postponed until the final setting occurred.

Possible Causes of an inaccurate cast of a Dental Arch:

- 1- Distortion of the hydrocolloid impression.
 - a) By partial dislodgement from tray.
 - b) By shrinking caused by dehydration.
 - c) By expansion caused by imbibitions, this occurs towards the teeth and result in an undersized cast.
- 2- A ratio of water to powder that is too high, while this may not cause volumetric changes in the size of the cast, resulting in a weak cast.
- 3- Improper mixing, resulting in a weak cast or cast with a chalky surface.
- 4- Trapping of air, either in the mix or in pouring, because of insufficient vibration.
- 5- Soft or chalky cast surface resulting from retarding action of the hydrocolloid or the absorption of necessary water for crystallization by the dehydrating hydrocolloid.
- 6- Premature separation of the cast from the impression.
- 7- Failure to separate cast from the impression for an extended period of time.

The mucinous exudate has got a retarding effect on any gypsum material resulting in a soft (easily abraded) or chalky cast surface. It's developed due to **syneresis**.