Laboratory work (Investing, burnout, casting and finishing procedures)

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


Fig. (1) Investment material

Objectives of investing:

1. It should provide an accurate reproduction of the anatomical form of the wax pattern.

2. It should provide sufficient strength to withstand the heat of the burnout procedure and the actual casting of the molten metal.

3. It should provide compensation expansion equal to the solidification shrinkage of the metal; therefore, the mold cavity should be larger than the wax pattern (if this does not happen, the restoration will be smaller than the wax pattern).

To do investing we need:

1. Casting ring.
2. Ring liner.
3. Crucible former.
4. Investment material.

Casting Ring: The casting ring is made of metal and is used to hold the investment material in place during its setting and to restrict its expansion. If we use the casting ring alonewe will not have expansion, so we need to use the ring liner to allow certain degree of expansion **Fig. (2)**.

Ring Liner: The liner is used to line the inside of the casting ring. It is made from a compressible material. e.g., asbestos (0.6mm thick) that allows the investment material to expand to some degree **Fig.(3).**

Fig. (2) Casting ring

Fig.(3) Ring liner

Crucible Former: It is a cone-shape base made of rubber or metal, which forms the base of the casting ring, and to which the other end of the sprue is attached **Fig.(4)** .

Fig.(4) Crucible Former

Purposes of using conical crucible former:

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

Mold Cavity:

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

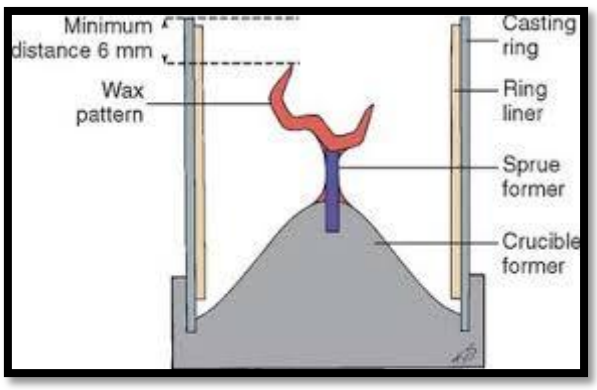


Fig. (5) Cross section of invested wax pattern in the casting ring

Investment materials:

According to the type of the binder, we have two types:

1. Gypsum-bonded investment material.
2. Phosphate-bonded investment material.

Both consist of a binder and a refractory material (silica).

1. Gypsum-bonded investment material:

The binder is calcium sulfate hemihydrate. It is used with an alloy which has a low melting temperature. At high temperature, decomposition of calcium sulfateoccurs which results in the release of sulfur into the mold and mixes with gold resulting in brittle casting, so it is unstable in burnout temperature above 650 ºC.

2. Phosphate-bonded investment material:

The binder is magnesium phosphate and ammonium phosphate. The binder can withstand high casting temperature; therefore, it is used for investing and casting alloys with higher casting temperatures.

Methods of mixing the investment material:

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

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

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

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

Burnout procedure: It is the heating of the invested ring (casting ring) in a thermostatically controlled oven at increased temperature to 200 C and hold for 30 min, the wax and water vaporize to create the mold cavity into which the molten metal can enter. The ring is heated to 480-650 C for final burnout procedure and leave it for 45 min.

Fig.(6) Oven for burnout

Fig. (7) Mold cavity

Notes:

- The position of the ring should be in the center of the oven so that the atmosphere surrounding the ring is the same.
- A too rapid increase of the burn out temperature may cause cracking of the investment and distortion of the mold cavity.

Casting: It is defined as introducing of the molten metal into the mold cavity inside the investing ring by using of casting machine.

Casting machine requires:

1. Heat source to melt the alloy (pipe torch).
2. Casting force to force the molten alloy into the mold cavity.

Fig. (8) Heat source to melt the alloy (pipe torch).

The most common casting machine is the centrifugal casting machine which consisting of a device (crucible) for melting the casting alloy, and another part for throwing the molten alloy quickly by the centrifugal action when the machine is giving three clockwise turns and locked in position with pin.

Fig. (9) Casting machine

Cleaning Of Cast Restorations

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

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

1. To anneal the alloy to provide better working qualities during finishing.

2. Disintegration of the hot investment material when it contact cold water.

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

Finishing Of the Cast Restoration:

- The sprue is cut by a Carborundum separating disc.
- Inspect the inner surface of the cast restoration for any nodules, bubbles of the metal that might interfere with seating of the cast restoration on the die (sometime we use magnification). All these irregularities should be removed using a round bur rotating at high speed
- The cast restoration (crown) is seated on the die. It should seat without any pressure
- adjusts the interproximal relationship to achieve a slight contact with the adjacent teeth
- Adjust the occlusal relationship in centric and eccentric relation to relieve any occlusal prematurity.
- The axial walls and the margin of the cast restoration are smoothed by a rubber wheel bur.

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

Advanced technology in crown & bridge fabrication:

CAD/CAM Technology:

Throughout the years, dentistry has gone through numerous developments in knowledge and technology; this has led to the development of the Computer Aided Design and Computer Aided Manufacture (CAD/CAM) system. Dental CAD/CAM is the process by which a prepared tooth or model of it is digitally scanned and these data are then used to generate a restoration design (CAD) which in turn is used to generate a cutting path for manufacturing the final restoration (CAM).

Fig(10). CAD/CAM system

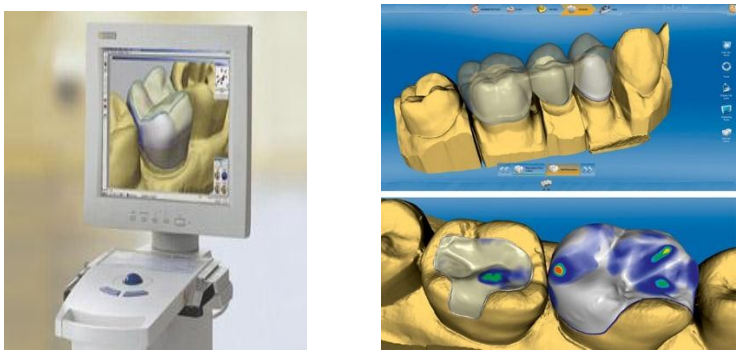
CAD/CAM components:

1. **Scanner:** which is the tool that measures tooth, structures and transforms them into digital data

Intra-oral scanner

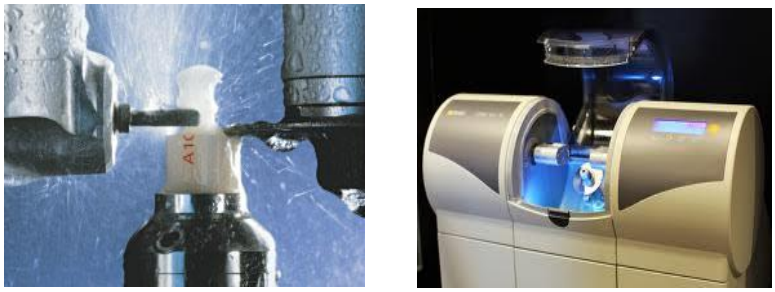
Extra-oral scanner

Software: Special software is provided by manufacture for the design of the various kinds of dental restorations such as crown and fixed partial denture framework or the fully anatomical restorations.



Software (designing of the restoration)

2. **Milling machine:** The data that produced with CAD software are converted into the final product (restoration) from suitable material blocks placed in the milling device.



Milling machine