

# Dental Impressions, Impression Materials, and Dental Stone

DENTAL MATERIALS LECTURE #4

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# Role of Dental Hygienist

- ▶ Understand which procedures require dental impressions
- ▶ Understand the differences between an analogue (physical) impression and a digital impression
- ▶ Understand Different types of Impression Materials, their particular properties and which procedures they are used for
- ▶ Understand Different types of gypsum stone and which procedures require which particular stone.

# Dental Materials #4 Outline:

- ▶ Procedures that require dental impressions
- ▶ Types of Impression Materials
- ▶ Hemostatic Agents
- ▶ Retraction Cord
- ▶ MaxilloMandibular Relation (MMR) = Bite Registration
- ▶ Disinfection of Impressions
- ▶ Gypsum Materials
- ▶ Articulator
- ▶ Digital Impressions

# Learning Objectives

- ▶ Understand why and how impressions are used in dentistry
- ▶ Understand which procedures require impressions
- ▶ Learn the types of impression materials and their respective properties
- ▶ Learn disinfection technique for impression
- ▶ Learn the types of gypsum stone and when each is used
- ▶ Learn how digital scanning impressions compare to traditional analogue impressions

# Procedures that Require Impressions

## **Anything that needs to be fabricated in the lab:**

- ▶ Diagnostic Casts/Study Models/Patient Records
- ▶ Indirect Restorations (crown, bridge, inlay, onlay, veneers)
  - ▶ Implant Restorations
  - ▶ Braces/Invisalign
- ▶ Oral Appliances (Mouth Guards, Athletic Guards, Sleep Apnea Devices, Bleaching Trays, retainers)
  - ▶ Partial/Complete Removable Dentures
- ▶ Maxillofacial Prosthetics (ie – missing ear/nose or obturator)

# What is a Dental Impression?

- ▶ Dental impressions are the negative imprint of the teeth and other parts of the oral cavity (gums, surrounding tissues, etc.); they are used to create an exact three-dimensional model of these structures.



# Dental Impression and Stone Model

- **Dental impression**=  
**Negative  
Reproduction**
- **Study Model**= **Positive  
Reproduction**



# What Does the Dental Lab Need?

- ▶ Impression of the prepared tooth or surface (or arch) for which the restoration or prosthesis will be fabricated
- ▶ A “counter” impression of the opposing surface (this lets us know how high to make the restoration or prosthesis)
- ▶ A bite registration or a record that relays the way the main impression and the counter impression relate to one another



# Impression Trays

- ▶ Metal Trays
- ▶ Plastic Trays
- ▶ Full Arch Trays
- ▶ Quadrant Trays (posterior quadrant and anterior Quadrant)
- ▶ Triple Trays
- ▶ Custom Trays

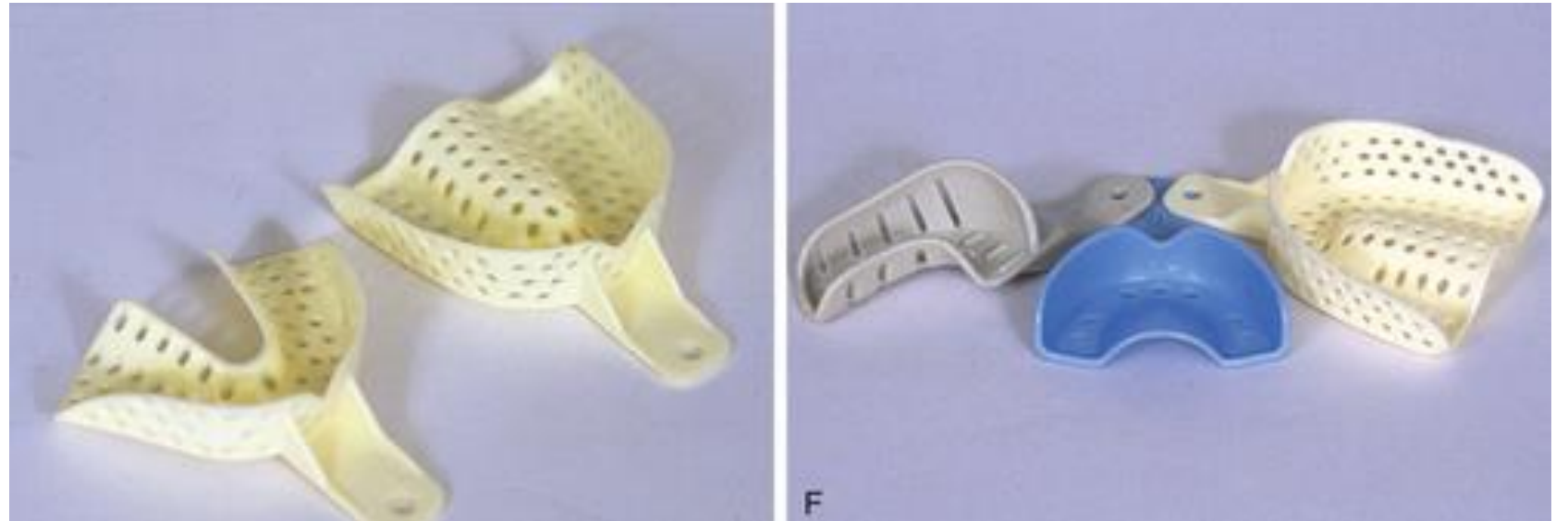
# Metal Trays

- ▶ Stiff
- ▶ Can be difficult to remove if using a stiff impression material
- ▶ Can be autoclaved



# Plastic Trays

- ▶ Easier to remove than metal trays
- ▶ Disposable



# Modification of Trays with Wax



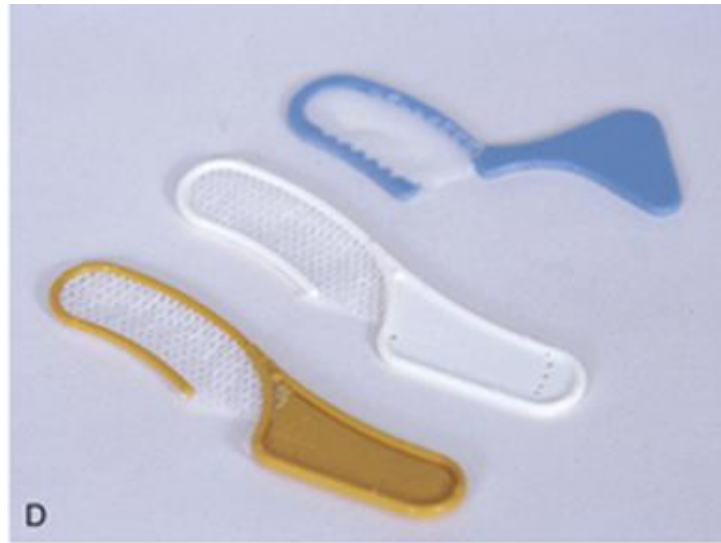
# Quadrant Trays

- ▶ There are quadrant trays for the anterior and posterior
- ▶ Used when only a few teeth are needed



# Triple Tray

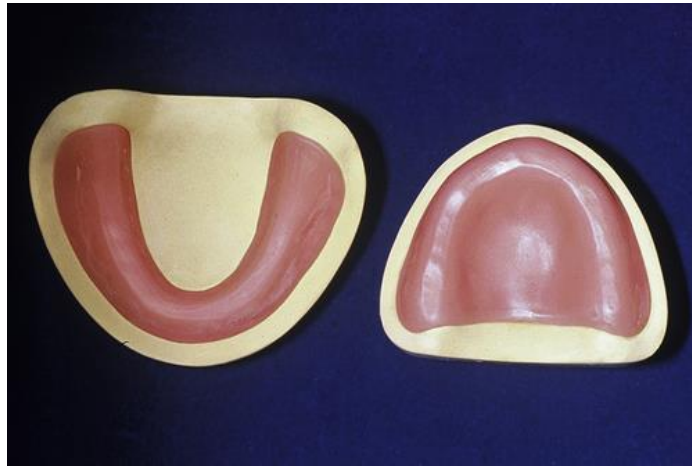
- ▶ Triple trays allow the operator to get a maxillary impression, the mandibular impression, and the bite all at the same time.
- ▶ They can save time
- ▶ Usually come as quadrant triple trays, but can be full arch triple tray





# Custom Trays

- ▶ Used most often in dentures, but can be used for indirect restorations.
- ▶ These trays are individually custom made for the patient. They require a preliminary impression + stone model of the teeth before they can be constructed.
- ▶ Normally fabricated by the dental lab, but can be done in the office.



# Impression Material Properties

- ▶ Accuracy
- ▶ Dimensional stability
- ▶ Tear Resistance
- ▶ Working Time
- ▶ Setting Time
- ▶ Hydrophobic vs Hydrophilic



# Impression Material Properties

**Dimensional Stability:** After the impression is removed from the patient's mouth, the set material does not change shape

**Tear Resistance:** The ability of the material to resist tearing when removed from the mouth, after the impression material sets intraorally. For instance, for a crown impression, the impression material in the gingival sulcus is very thin and would tear if the tear resistance is poor

**Working Time:** The Amount of time prior to onset of setting that the material can be manipulated into the correct position (this includes loading the impression tray and seating into correct position intraorally).  
From time of mix until seated in mouth.

**Setting Time:** Once properly positioned intraorally, the amount of the until the impression material is fully set (hardened).

# Hydrophilic vs Hydrophobic

**Hydrophilic**: having a tendency to mix with, dissolve in, or be wetted by water.

**Hydrophobic**: tending to be repelled by or fail to mix with water.

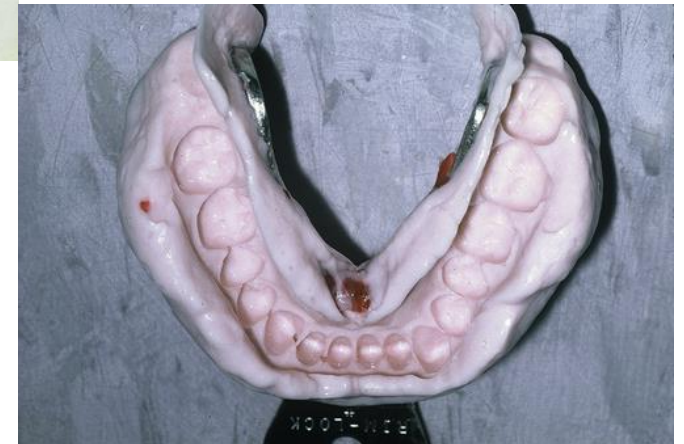
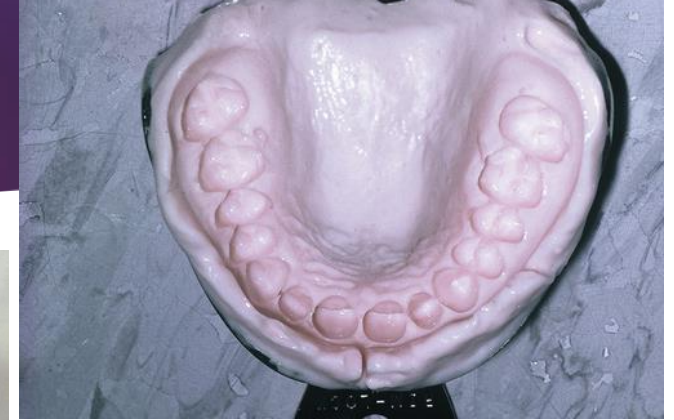
A hydrophilic impression material is expected to flow into moist areas and copy surfaces correctly, resulting in fewer chances of air entrapment in the impression.

# Types of Impression Materials

- Alginate (Irreversible Hydrocolloid)
- Polyvinyl Siloxane (Elastomer)
- Polyether (Elastomer)

# Alginate

- ▶ Irreversible Hydrocolloid
- ▶ Lacks the accuracy and fine surface detail needed for final impressions during crown and bridge procedures (indirect restorations)
- ▶ Use for diagnostic study models, oral appliances, fabrication and repair of partial dentures/complete dentures



# Preparing to Mix

- ▶ Before scooping the alginate, make sure to “fluff” the alginate container
- ▶ Take a heaving scoop, “chop” the top of it with the alginate spatula and then level the scoop with the spatula.
- ▶ Use Room temperature water
- ▶ Use the Water Measuring Cup
- ▶ One Scoop of Alginate per one Unit of Water
- ▶ Add Powder to Liquid

# Spatulation

- Mixing quickly causes the material to set faster
- Mixing more slowly will give you more working time
- Fill the tray from posterior to anterior

# Alginate Properties

**Syneresis**– a characteristic that when left standing, the alginate will contract and squeeze out some liquid that then accumulates on the surface. This results in shrinkage of the material.

**Imbibition**- the impression absorbs water, such as during long exposure to disinfecting solutions. This causes expansion.

**Gelation**- the setting process of the alginate material.

**Hysteresis**- a material's characteristic of having a melting temperature different from its gelling temperature.

# Alginate Properties

- ▶ Lower Accuracy

- ▶ Lower Dimensional Stability:

- Very sensitive to moisture and will start to shrink (syneresis) when removed from the mouth

- If left in water, will imbibe and start to swell

- Once alginate is removed from mouth and disinfected, ideally it should be poured right away. If it cannot be poured right away, it should be wrapped in a damp paper towel in a zippered bag to minimize distortion

- ▶ Lower Tear Strength than PVS or Polyether

- Alginate mixed with too much water is weaker and more likely to tear when removed from the mouth.

- It is advisable to leave the impression in the mouth for an additional minute after it appears to be set because the tear strength and ability to rebound from undercuts without permanent deformation increases during that time.



# Alginate Permanent Deformation

- ▶ Alginate is compressed when removed from undercuts in the mouth. The greater the compression, the greater amount of permanent deformation, which will lower the accuracy.
- ▶ If you wait 8-10 minutes before pouring alginate impression, slight rebound will occur (the alginate retakes its shape), which minimizes permanent deformation.

# Elastomers



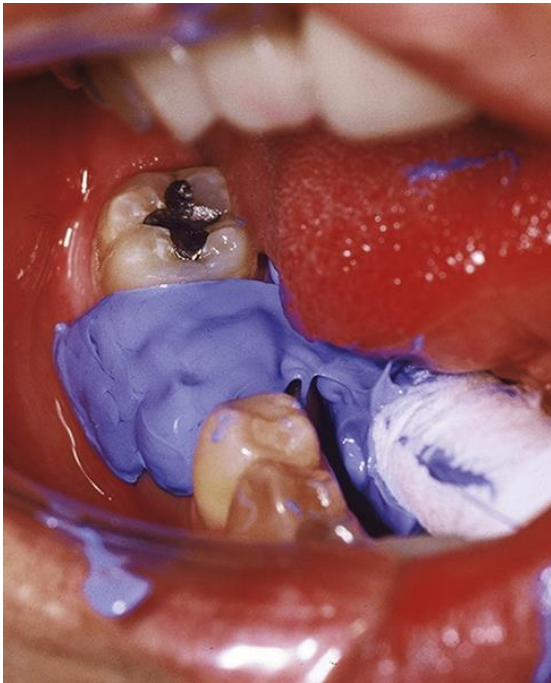
# Elastomers

- ▶ Highly accurate elastic impression materials that have qualities similar to rubber.
- ▶ High tear strength
- ▶ Improved elastic recovery vs. alginate which results in less permanent deformation.
- ▶ Two most widely used elastomers are polyether and polyvinyl siloxane.
- ▶ Less sensitive than hydrocolloids to syneresis or imbibition
- ▶ Come in multiple viscosities: Light, medium and heavy body

Types of Elastomers	Similarities	Differences
<p>Polyether</p>	<ul style="list-style-type: none"> <li>• Highly accurate</li> <li>• Can be used for almost any impression application in dentistry. Used most often for indirect restorations.</li> </ul>	<ul style="list-style-type: none"> <li>• Does not release any hydrogen gas. Can be poured immediately.</li> <li>• More hydrophilic than PVS. More forgiving of moisture than PVS, but still requires a dry field.</li> </ul>
<p>Polyvinyl Siloxane (PVS): Also referred to as Vinyl Polysiloxane (VPS). <b>PVS</b> and <b>VPS</b> will be used interchangeably to describe it</p>	<ul style="list-style-type: none"> <li>• Can wait up to 1 week before pouring</li> <li>• Can pour the same impression more than once</li> </ul>	<ul style="list-style-type: none"> <li>• Gives off hydrogen gas after setting. Therefore should wait 1 hour before pouring impression</li> <li>• It is an Addition Silicone impression material</li> <li>• Best elastic recovery of all elastomer materials (minimizes deformation).</li> </ul>

# Elastomer Impressions

- ▶ Come in various viscosities (light body, medium body, heavy body)
- ▶ Very often a **light body** will be dispensed directly on the tooth/teeth that have been prepared and right after an impression tray with **medium or heavy body** is seated on top of the light body.



# Disinfecting Elastomer Impressions

- ▶ After removal from the mouth, rinse thoroughly with water to remove saliva, blood, debris, etc.
- ▶ Shake off excess water prior to using disinfectant
- ▶ Spray impression material with disinfectant and rinse after recommended contact time



# Summary

- ▶ Polyether and PVS are the most accurate
- ▶ Polyether and PVS have best dimensional stability
- ▶ Polyether and PVS have best tear resistance
- ▶ Alginate is least expensive and easiest to remove

# Dispensing

- ▶ Elastomers are usually dispensed via cartridge with two chambers (one base, one catalyst). A hand operated gun-type dispenser or a motor-driven dispenser pushes the base and catalyst through a mixing tip at the same time.
- ▶ The motor-driven dispenser is known as a Pentamix machine.
- ▶ PVS is also available as a Putty



# Elastomer Gun-Type Dispenser and PVS Putty



# Pentamix Machine



# Tray Adhesive

- ▶ Sometimes an adhesive is placed into the impression tray to improve retention of the impression material in the impression tray
- ▶ Each type of elastomer has its own adhesive:
  - Polyether requires polyether adhesive
  - PVS requires PVS adhesive
- ▶ Tray adhesive should be applied in a thin layer and be allowed to dry before taking the impression.
- ▶ Sometimes alginate is used with a tray adhesive.

# Gingival Retraction

- ▶ Retraction of the marginal gingiva is often needed for impressions for teeth prepared for restorations such as crowns and bridges, especially when the preparation extends subgingivally.
- ▶ The objective of gingival retraction is to provide a space in the gingival sulcus where impression material can flow such that 0.5mm of tooth beyond the crown margin can be captured.

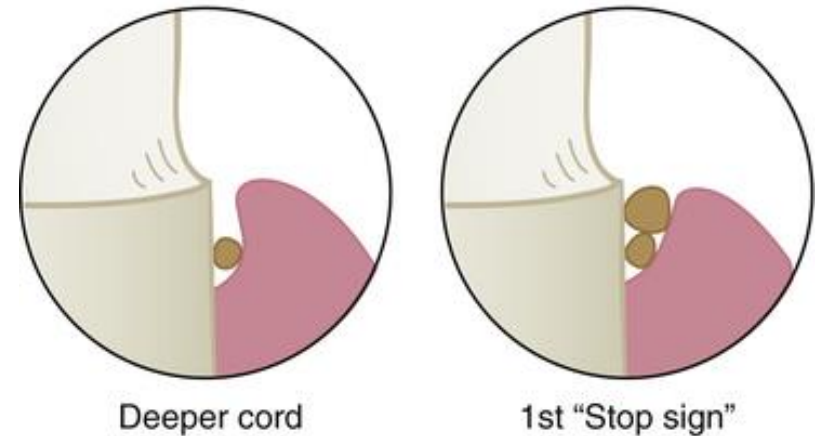
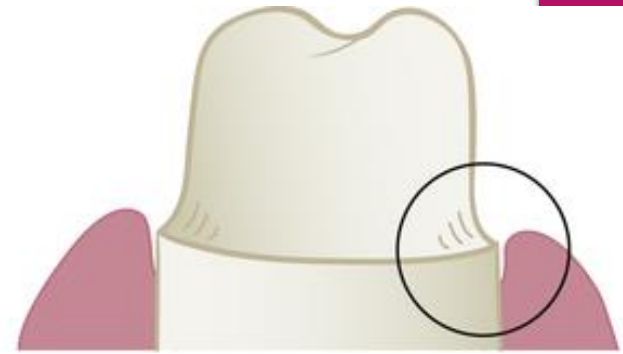
Dental assistants and hygienists frequently are involved in the impression making process. Those that are licensed in expanded functions may actually pack retraction cord, use astringents, and take the impressions for crowns and bridges.

# Methods of Gingival Retraction

- ▶ Retraction Cord
- ▶ Astringent/Hemostatic Agents
- ▶ Retraction Paste
- ▶ Laser or electrosurgery

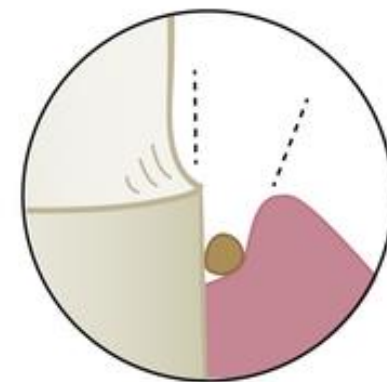
# Retraction Cord

- ▶ Placement of gingival retraction cord into the gingival sulcus.
- ▶ Often two cords are placed. One thinner cord, followed by one thicker cord. The thicker cord is removed right before the impression is taken.
- ▶ Cord ranges from 000 (very thin) to 3 (very large)
- ▶ Sometimes the retraction cord comes out with the impression. That is okay.



Deeper cord

1st "Stop sign"



2nd "Stop sign"

# Retraction Cord and Dental Impression





# Astringents and Local Hemostatic Agents



Quick-Stat Vista  
(Ferric Sulfate)



Hemodent  
(Aluminum Chloride):



Local Anesthetic with  
**Epinephrine**



# Retraction Paste/Silicone/Gel

- ▶ These are thicker pastes that contain astringent. The paste is placed in the gingival sulcus for >2 minutes and then rinsed away before taking the impression. Sometimes the patient will also bite on a compression cap (the pressure causes retraction)

-Traxodent (Aluminum Chloride)

-3M Astringent Retraction Paste (Aluminum Chloride)

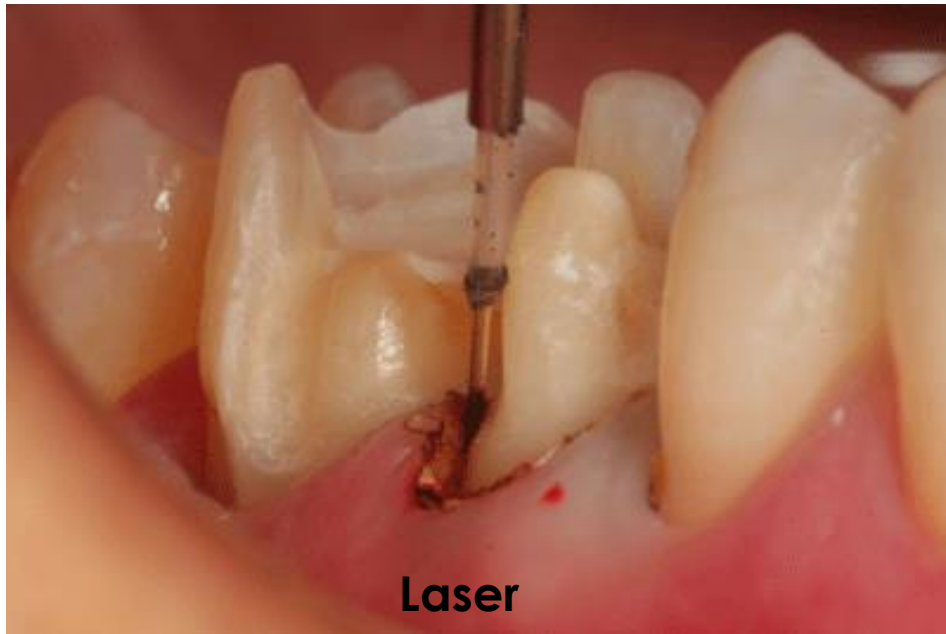
-Dryz (Aluminum Chloride)



# Lasers & Electrosurgery

# Lasers and Electrosurgery

- ▶ Lasers and Electrosurgery can be used to remove excess gingival tissue or produce a small trough in the gingival sulcus where the impression material can then flow.
- ▶ **Electrosurgery should NOT be performed next to metal restorations**



# Impression Techniques

**One-Step Technique**: Place the light body impression material directly over the prepared tooth and then seat the impression tray containing the medium or heavy body over all the teeth to be impressed.

**Two-Step Technique**: First take an impression of the desired teeth with just the medium or heavy body in the impression tray. Then, once the impression sets, place light body impression material over the prepared teeth and reseal the impression tray.

# Bite Registration

# Bite Registration

- ▶ Bite Registration also known as the MMR (Maxillomandibular Relationship)
- ▶ Allows the maxillary and mandibular stone models to be accurately articulated (“matched”) together. Shows how the maxillary teeth relates to the mandibular teeth (or how the maxillary arch relates to the mandibular arch).
- ▶ Usually obtained by having the patient bite down on a fast setting PVS material.



# Bite Registration





# Pouring UP the Dental Model



# Pouring up the dental impression

- ▶ We use Gypsum stone to pour up the impressions
- ▶ After pouring up the impression with stone, it is referred to as the dental cast or dental model.

## To Review

**An impression:** A negative reproduction of the patient's mouth

**Stone Model:** hard, stable positive reproduction or cast of the hard and soft tissues

# Impression and Stone Model



# Types of Stone Models

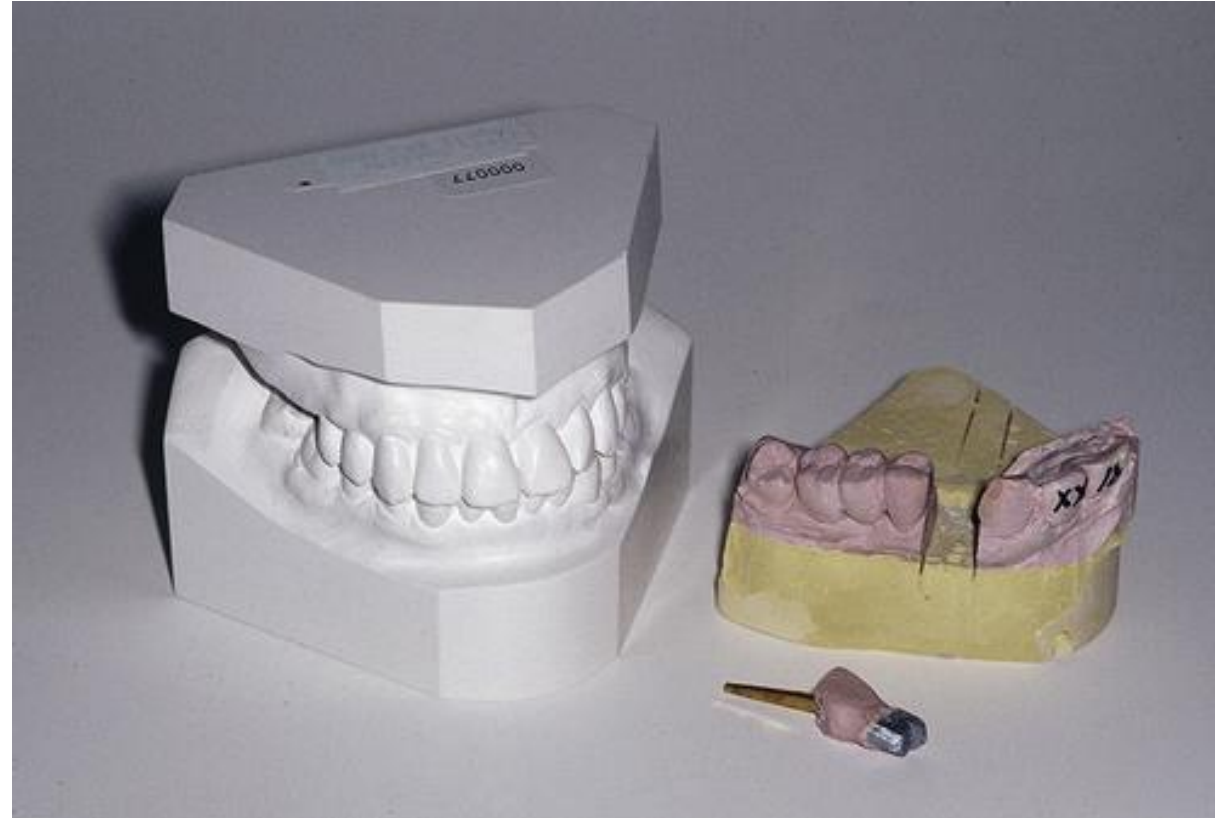
The intended or desired function of the stone model will determine the type of gypsum stone that is used to pour up the impression

**Diagnostic Cast**: Also called **study models**. They are used to plan treatment and to observe the oral structures of the mouth.

**Working Cast**: Also called **working model**. Used to fabricate appliances such as orthodontic retainers or bleaching trays or removable prosthesis (partial or full denture)

**Dies**: Dies are replicas of individual teeth or groups of teeth and are used to fabricate crowns and bridges

# Diagnostic Cast, Working Model and Die



# Gypsum

- ▶ Gypsum is a mineral widely found in nature.
- ▶ Calcium Sulfate Hemihydrate + Water → Dihydrate of calcium sulfate (exothermic)
- ▶ Plaster contains the most excess water of the various gypsum mixes and therefore produces bigger and more numerous air voids; die stone contains the least excess water and therefore produces fewer, smaller air voids

## 5 types

- 1) Impression Plaster (Type I) – weak, rarely used **\*Weakest Dental Stone.**
- 2) Model Plaster (Type II) – weak, very porous. Used for Study Models.
- 3) Dental Stone (Type III) – working casts/fabrication oral appliances/dentures
- 4) Die Stone (Type IV) – very dense, high strength. Used for dies/crown and bridge
- 5) Dental Stone (Type V) – very dense. **\*Strongest Dental Stone.**

**The more water needed = weaker final product (less strength, less hardness, less resistance to abrasion)**

**Type I Impression Plaster → Weakest (most porous stone, most water needed)**

**Type V Dental Stone → Strongest (least porous stone, least water needed)**

# Gypsum

- ▶ Calcium Sulfate Hemihydrate + Water → Dihydrate of calcium sulfate (exothermic)
- ▶ The gypsum reaction involves adding water to the hemihydrate to convert it back into dihydrate.
- ▶ **The more water that is used, the weaker the final product (less strength, less hardness, less resistance to abrasion)**
- ▶ **The more porous the hemihydrate (the gypsum powder), the more water it will require to convert back into dihydrate.**

## Type II: Model Plaster

- ▶ **White**
- ▶ Plaster particles are more irregular and porous
- ▶ **Weak (lower strength, hardness, resistance to abrasion)**
- ▶ Greatest expansion
- ▶ **Used for diagnostic models and to articulate models on articulator**

## Type III: Dental Stone

- ▶ **Colored Yellow** or White (usually **Yellow**)
- ▶ **Requires less water and is stronger than model plaster**
- ▶ **Used for full or partial denture models, orthodontic models.**
- ▶ Plaster particles are uniformly shaped, relatively nonporous crystals



## Type IV: Dental Stone: High Strength/Low Expansion

- ▶ **Referred to as Die Stone**
- ▶ Green or Pink (Usually green)
- ▶ Crystals are slightly larger and more dense than type III
- ▶ **Very dense, high strength, low expansion**
- ▶ **Used for crown and bridge**

## Type V: Dental Stone High Strength/High Expansion

- ▶ Strongest Gypsum Product.
- ▶ Colored blue or green
- ▶ Contains particles of silica
- ▶ Requires the least water
- ▶ The Expansion is used to compensate for the greater casting shrinkage of newer base metals

# Trimming Stone Models

- ▶ Once poured, the stone should be allowed to set
- ▶ Once set, the stone should be removed from the impression
- ▶ The stone models are then trimmed on a Model Trimmer



# Trimming the Stone Model



# Articulator





# Dental Scanners



# Dental Scanning During Hygiene Appointments

- ▶ It is becoming more common to take a diagnostic scan of a patient's teeth during hygiene appointments
- ▶ This gives a great visual for patient education
- ▶ Itero scanners, in particular, can give orthodontic simulations which can be especially motivating for a patient to commit to Invisalign treatment.

# Invisalign Simulation





# Advantages of Digital Scanners

- ▶ Easier for patient to tolerate
- ▶ Can be more accurate (no distortion of impression material or dental stone)
- ▶ Dentist can visualize preparation in real time and modify accordingly if needed
- ▶ Impression can be sent to the dental lab electronically (physical impressions have to be sent through the mail)
- ▶ Can reduce turnaround time for final restoration

# Disadvantages

- ▶ Not necessarily faster than taking an analogue (physical) impression
- ▶ Can be more difficult to get adequate gingival retraction
- ▶ Limitations of scanner technology:
  - If the digital scanner cannot physically see aspects of the preparation, it cannot scan it. This applies especially to subgingival preparations
  - Impression material can flow below the gums and around a subgingival preparation that a digital scanner would otherwise not be able to see.



**The End**