Alginate Impression and Diagnostic Study Model Techniques

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Continuing Education Units: 3 hours

This continuing education course is intended for general dentists, hygienists, dental assistants and dental students. Accumulation of dental data provides the foundation for comprehensive dental care. Alginate impressions and study models have been used in dentistry for years, primarily to aid in diagnosis and treatment planning. This CE course is intended to show how alginate impressions and study models are a valuable adjunct in providing optimal patient care.

Conflict of Interest Disclosure Statement
The authors report no conflicts of interest associated with this work.

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Overview
Accumulation of dental data provides the foundation for comprehensive dental care. Alginate impressions and study models have been used in dentistry for years, primarily to aid in diagnosis and treatment planning. Alginites are elastometric by nature and offer the flexibility and duplicating properties to obtain an accurate impression. These impressions are poured up in gypsum to obtain models or casts. Study models are frequently used for presentation purposes and as a visual aid for patient education. These models provide excellent legal documentation and serve as one component of the permanent record of
patients’ oral condition. Study models also provide occlusal representation to identify Angle’s classification of (mal)occlusion which defines the relationship of the maxillary and mandibular teeth in the sagittal plane. Additionally, they provide recognition of wear patterns, missing teeth, drifting teeth, actual size reproductions of anatomical structures including tooth size, shape, positions, gingival margins, interdental papillae, and the freni. Alginate impressions and study models are a valuable adjunct in providing optimal patient care.

Learning Objectives
Upon the completion of this course, the dental professional will be able to:
- Describe the properties and characteristics of irreversible hydrocolloid and gypsum.
- Define working time and setting time as these terms relate to working with alginate and gypsum products.
- Demonstrate proper infection control procedures when using alginate and gypsum materials.
- Discuss the guidelines used in impression tray selection.
- Describe the rationale for obtaining the mandibular impression prior to the maxillary impression.
- Identify three mechanisms available for mixing alginate material.
- Differentiate between a smooth vs. a grainy mix of alginate material and what precautions should be taken for insuring a homogeneous consistency.
- Explain how to seat and remove a maxillary and mandibular impression including patient and operator positions.
- Describe the appropriate mandibular and maxillary impression removal technique.
- Elaborate on the protocol for impression storage.
- Explain the purpose of a bite registration and three ways to obtain one.
- State six desirable characteristics required of gypsum products.
- Explain the rationale for gradually sifting the plaster powder into the water in the mixing bowl.
- Describe the technique for filling the teeth in the impression with plaster.
- Identify and describe four methods of forming a study model base.
- Describe the separation procedure that should be followed to remove a cast from the impression and detail the necessary precautions that should be taken.
- Describe the trimming procedure for the maxillary and mandibular models.
- Describe the sanding and polishing techniques used for finishing diagnostic study models.
- Discuss the proper labeling and storage of study models.

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Glossary

**Accelerator** - any material that hastens or speeds up the chemical reaction of a material; a catalyst.

**Alginate** - an irreversible hydrocolloid predominantly used to construct diagnostic study models.

**Anatomical portion** - the area of the cast that represents the teeth and surrounding dental anatomy including the oral vestibule and freni.

**Articulation** - the contactual relation of the maxillary and mandibular teeth as they intercuspate.

**Art portion** - the base that supports the anatomical portion of the diagnostic cast.

**Chromatic agents** - ingredients that produce color change.

**Disinfection** - the process of reducing the number of disease-producing microbes to a safe level.

**Emesis basin** - a kidney shaped receptacle made of plastic or metal.

**Exothermic** - a chemical reaction that releases energy in the form of heat.

**Gypsum** - a natural mineral found in mines; known as calcium sulfate dihydrate and water.

**Homogeneous** - containing properties that are totally uniform and consistent throughout.

**Imbibition** - the absorption of water that creates distortion through swelling.

**Loss of gloss** - when the shiny appearance of gypsum acquires a dull finish.

**Occlusion** - intercuspation of the maxillary and mandibular teeth.

**Retarders** - any material that slows down the chemical reaction of a material.

**Spatulation time** - the time required for thoroughly mixing alginate or gypsum.

**Study models** - the positive reproduction of the oral cavity, which includes the anatomical and art portions.

**Syneresis** - the loss of water that creates distortion through shrinkage.

**Working time** - the time that elapses between the incorporation of ingredients up to the point just prior to setting.

**Alginate**
Alginate is an elastic impression material made from seaweed. It is also comprised of sodium alginate, calcium sulfate and retarders. It is used to take primary or preliminary impressions. This colloidal material forms a gel when the powder is mixed with water. It solidifies into an elastic mass capable of producing a negative reproduction of the oral cavity (an impression). It is sometimes referred to as an irreversible hydrocolloid because once it is mixed a chemical reaction has occurred. Therefore, it can never return to its original state of powder and water. Alginate impressions are taken to obtain diagnostic study models, which are the positive reproductions of the teeth and surrounding structures. They are also used to fabricate bleaching trays and mouthguards. Alginate is the most universally utilized impression material in dentistry. The following are characteristics of an ideal alginate impression material:
Packaging
Alginate impression powder is packaged in bulk canisters, one pound poly bags or pre-weighed single use packages (Figure 1). It is recommended that the powder in the poly bag be transferred into an airtight canister after its initial opening. It is cost effective to purchase alginites in bulk. However, the individual unit dose package offers convenience, accuracy and extended shelf life. It is important to store alginate in a cool, dry area in an airtight container to prevent moisture contamination and prolong the shelf life. Keep in mind that exposures to atmospheric humidity will adversely effect the setting times and markedly decrease the shelf life of alginate. Therefore, alginate canisters should never be left opened or without the lid tightly secured.

Setting Times
Alginites may be purchased in regular, fast and extra fast set varieties. These set times control the working time and the setting time of the material. The working time is the actual time permitted to spatulate the alginate, load the tray and seat the tray in the mouth. The setting time is the amount of time necessary for the alginate to become an elastic mass prior to the tray removal from the mouth. The ADA specification Type I/Fast Set has a working time of one minute and a setting time of 1-2 minutes. The ADA specification for Type II/Normal Set has a working time of 1-2 minutes and a setting time of 2-4 minutes. The temperature of the water can alter the working and setting times. Ideally, the water temperature should be 73 degrees F or as close to room temperature as possible. An increase in the water or powder temperature decreases the working and setting times, while a decrease in the water or powder temperature increases the working and setting times. It is recommended that a dispensing bottle be filled with water and held at room temperature to provide product consistency. Improper water/powder ratios can also affect the setting time.

Flavoring the Impression
Flavoring the impression makes the procedure more palatable for the patient. Bubble gum, grape and mint are examples of flavors that may be already incorporated in the powder. For unflavored alginites, flavored liquid drops can be added to the water before mixing the alginate. Offering the patient a choice of flavors often gives the individual a feeling of control. This can enhance the patient’s cooperation level, thus producing a pleasant experience.

Properties of Powder
Alginate powder may be supplied in regular or dustless forms. Dustless powder is manufactured
in an effort to reduce harmful effects to the operator. However, this does not eliminate the need to wear Personal Protective Equipment (PPE) during this procedure. The operators must protect themselves from adverse reactions by wearing personal protective equipment, such as masks, protective eyewear, gowns and gloves, when handling alginates. Without the use of PPE, minute dust particles may be inhaled into the lungs. Prolonged exposure may lead to respiratory problems and/or allergic reactions. The dust can also migrate behind contact lenses and irritate the eyes. The manufacturers of alginate must supply Material Safety Data Sheets (MSDS). In accordance with OSHA’s regulations, the employer is required to maintain MSDS sheets in a reference file for employees to access. The operator should read the MSDS sheets prior to handling alginates, paying special attention to the Health Hazard Data section (Figure 2).

Disinfecting Protocol/Technique
Antimicrobial agents are incorporated into some brands of alginate but do not substitute for disinfection. Rinse the impression under gently running, room temperature tap water. Spray the impression and tray with an immediate-level hospital grade (capable of killing tuberculocidal activity) disinfectant of choice. (The most accurate casts are associated with disinfection of alginate impressions by spray rather than by immersion.) Place the wet impression in a plastic bag, seal, and allow to remain for the amount of contact time recommended by the manufacturer. A label can be affixed to the bag for proper identification. After the required amount of time, remove the impression from the bag and, under room temperature tap water, rinse the disinfectant away. Pour as usual. IMPORTANT: If disinfection of the impression is not completed properly, the gypsum cast will be contaminated and capable of transmitting disease.

Following the manufacturer's instructions for disinfectant contact time lessens the opportunity for distortion of the impression, whether spraying or soaking. Dehydration is an important factor in impression distortion and is easily controlled. Once the impression is disinfected and rinsed, it should be poured at once. All alginates are subject to shrinkage from dehydration. If the impression cannot be poured at once, the impression must be held in a moist environment (sealed plastic bag) until it can be poured. Alginates should be poured within 30 minutes for best results. If this is not possible, it can be stored in a holding solution, Extend-A-Pour®, for up to thirty days.

Chromatic Alginates
Alginates may be manufactured with chromatic agents that have color indicators in the powder. The color of the mix changes throughout the manipulation of the product. For example, the white powder may change to a deep purple during the mixing phase, turn pink for insertion into the tray and then turn white when the tray is seated. These color changes alert the operator when to end spatulation, when to fill the tray and when the alginate has set. This built-in indicator is an excellent guide for the operator to gauge the various stages of the procedure. The tray does not have to be seated until the last color change, thus reducing the amount of time the tray remains in the patient’s mouth. This feature is particularly important for the patient with gagging tendencies. These color changes vary with each manufacturer and may vary based upon the pH of the water used.

Reversible/Irreversible Hydrocolloid
To obtain the greatest detail and unsurpassed accuracy from an alginate impression, it is also possible to combine a standard alginate with a reversible hydrocolloid that is specially formulated to bond with alginate. The reversible material is packaged in glass vials the size of an anesthetic vial. The material is prepared by heating the vials in a small metal block heater that will also maintain the material in a warm, ready-to-use state for five days. When making the impression, the hydrocolloid vial is placed into a non-aspirating syringe, then applied to the preparation (for fixed or when fabricating an indirect provisional), to the guide planes and rest seats (for removable), or on all of the coronal surfaces (when making a custom bleach tray, or when fabricating an indirect model that will be later-read by a cad-cam system).

Armamentarium/Supplies and Equipment
The following supplies and equipment are necessary for taking alginate impressions:
## Dux Dental Material Safety Data Sheet

**Van R, Cadcu, Clive Craig**  
600 E. Hueneme Road  
Oxnard, CA, USA  
Phone: 805.488.1122  
Fax: 805.488.2266  
www.duxdental.com

### Hazardous Ingredients

<table>
<thead>
<tr>
<th>Principal Hazardous Components</th>
<th>CAS Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diatomaceous Earth (may contain up to 60% crystalline silica as cristobalite)</td>
<td>14464-46-1</td>
<td>NA</td>
</tr>
<tr>
<td>Potassium Titanium Fluoride</td>
<td>1.691 9-27-0</td>
<td>NA</td>
</tr>
</tbody>
</table>

### Physical and Chemical Characteristics

- **Appearance**: Dry powders of varying densities, colors, flavors, and final viscosities.
- **Boiling Point**: NA
- **Melting Point**: NA
- **Vapor Pressure**: NA
- **Evaporation Rate**: NA
- **Density**: NA
- **Specific Gravity**: Varies w/product
- **Water Solubility**: Gel Former

### Fire & Explosion Data

- **Explosion**: Not considered to be an explosion hazard.
- **Fire**: Not considered to be a fire hazard.
- **Flashpoint**: NA
- **Special Fire Precautions**: None
- **Unusual Hazards**: None Known

### Toxicity Data

- **Acute Hazards**: Inhalation: NA  
Ingestion: NA
- **Inhalation**: May cause irritation if pel is exceeded.  
Control dust below pel level.
- **Ingestion**: May cause irritation, flush area with water for 15 minutes. Call physician.
- **Skin/Eye Contact**: No harm via exposures of normal use; harmful only due to overwhelming dose or unusual conditions.

### Chronic Hazards

- **Carcinogenicity**: Crystalline silica not listed by NTP or OSHA, suspect carcinogen per IARC.
- **Carcinogenicity**: Yes, in excess of pel

### Precautions for Safe Handling and Use

- **Carcinogenicity**: Yes, in excess of pel

### Additional Information

- **DOT Hazard Class**: Not Regulated
- **DOT Small Qty Exception**: NA
- **DOT Other Exception**: NA
- **DOT Exception Permitted**: NA

### Allergenic Ingredients

- **Allergenic Ingredients**: This product does not contain Latex, Peanut Products, Gluten, or Red Dye #3.

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**Figure 2. Dux Dental Material Safety Data Sheet**
Armamentarium for Alginate Impressions

- Basic set-up
- Room temperature water and powder
- Water measuring device
- Flavor drops (optional)
- Alginate powder
- Powder measuring device
- Flexible rubber mixing bowls
- Wide blade spatulas
- Maxillary and mandibular impression trays
- Adhesive (optional)
- Beading/utility/rope wax
- Bite registration material
- Disinfectant
- Paper towels/emeses basin
- Plastic bag
- Waterproof pen for patient identification purposes
- PPE for operator

Manufacturer's Specifications
It is imperative to follow the manufacturer's specifications for manipulation and use of alginate. Avoid interchanging the powder and water measuring devices from various manufacturers as these devices vary and will affect the accuracy of the mix.

Patient Preparation
Seat patients in an upright position and attach a large patient napkin to prevent spillage of material on clothing. A brief oral examination is necessary prior to taking an alginate impression. The purpose of this exam is to inspect the oral cavity for debris which should be removed prior to taking the impression. At this time, the operator should examine the palatal region for size and height. This will alert the operator to adjust the amount of alginate required for full anatomical coverage, i.e. if the palate is shallow, the operator should remove excess alginate material to avoid gagging the patient. Conversely, patients presenting with a high palate will require additional alginate material in this area to prevent voids. Also at this point, it is imperative that the patient takes out any removable dental appliances, oral piercings or grills. The operator should observe the lip area for dryness and chapping to see if it is necessary to lubricate the lips with petroleum jelly for the patient's comfort. Ask the patient to rinse with mouthwash to reduce the number of microorganisms in the oral cavity, as well as minimize air bubbles that can be produced by saliva.

Paper towels or tissues and an emesis basin are placed within the operator's reach in the event of a gagging episode and subsequent vomiting accident. Explain the procedure to the patient. The operator may ask, "Have you ever had impressions taken before?" Observe the patient's verbal and nonverbal response. Negative responses may indicate a bad prior experience or exposure to preconditioning. Reassuring the patient at this time is crucial. The operator should display a confident attitude. Convey positive information to assure a successful outcome. Basic instructions can be given at this time, such as telling the patients that the pudding-like material will feel cool, that it will set soon and that deep breathing through the nose will make the procedure more comfortable. Do not overload the posterior areas of the tray and remove the impression from the oral cavity as soon as it is set also helps the gag reflex.

Tray Selection
Alginate trays are available in a variety of sizes: extra small, small, medium, large and extra large. Full maxillary and mandibular trays are supplied in metal, plastic or Styrofoam. Perforated disposable trays are made of plastic and are meant for single use. Perforated trays are recommended because the alginate material flows through the holes, or perforations, which provide a mechanical lock of the alginate to the tray. This mechanical lock insures that the alginate and the tray are removed from the patient's mouth as one unit. Solid or perforated metal impression trays must be cleaned and sterilized prior to reuse. The operator should try each mandibular and maxillary tray in the patient's mouth to insure a proper fit before the alginate impression is taken. The impression tray "try in" also provides the patient with a preview of how the tray will feel once it is placed in the oral cavity. NOTE: All trays that are tried in the patient's mouth but do not fit correctly must be sterilized prior to restorage. Criteria for tray selection includes:
Criteria for Tray Selection

- Trays should extend distally to cover the maxillary tuberosity and cover the mandibular retromolar pad for maximum anatomical reproduction.
- Tray height should fully cover the length of anterior and posterior teeth.
- Tray should extend beyond the facial aspect of the teeth with a few millimeters of space between the tray and soft tissue.
- The tray size should be comfortable for the patient.

Adhesives

When using plastic trays, it is recommended that an alginate adhesive be used. Alginate adhesives are supplied in brush-on or spray-on form. It is recommended that the adhesive be placed inside the tray 5-10 minutes prior to the insertion of the mixed alginate material. The purpose of the adhesive is twofold:

1. The adhesive holds the impression material to the tray so that the tray and alginate come out of the patients mouth as one unit.
2. To prevent distortion of the impression by securing the alginate tightly against the side of the tray.

Admittedly, there exists controversy within the dental community as to the justification for the use of alginate adhesives. Repeated success has been experienced over the years without applying alginate adhesives. Moreover, the use of alginate adhesives adds expense to the procedure, adds an extra step in obtaining an alginate impression, requires planning for time management as well as for scheduling purposes and productivity and creates additional clean-up time.

Utility/Beading Wax

Utility/beading wax (sometimes referred to as periphery/rope wax) may be used to customize the tray for patient needs. Wax may be added to the borders of the tray to extend its length or height. The anterior region of the tray may be lined with two utility/beading ropes of wax and three utility/beading ropes of wax to maximize anatomical coverage in the vestibular and freni areas. Patients presenting with high palates can have wax placed in the palatal area on the inside of the tray. This will compensate for the high palate and will eliminate voids in the palatal area of the impression. Wax may be placed around the tray periphery to protect and cushion the soft tissues in the oral cavity. The placement of utility wax on the posterior region of the maxillary tray prevents excessive alginate from flowing down the throat; this will help prevent the activation of the gag reflex.

Alternatives to Hand Mixing

Two alternatives exist for mixing alginates other than manual manipulation of the impression material. The Alginator and the Vac-U-Mix automatically mix the alginate through the use of motorized electrical equipment.

The Alginator is a small countertop piece of equipment (Figure 3) that produces consistent uniform and homogeneous alginate mixes. Instead of manual hand spatulation, the Alginator rotates the bowl automatically at 300 times per minute. Read the manufacturer's operating instructions before using this equipment.

The following are general guidelines to follow:

Steps to Use Alginator

- The flexible mixing bowl is guided into the Alginator and turned clockwise to lock it in position.
- Powder and water are added to the bowl and blended together by hand.
- The Alginator is turned on.
The spatula is held by the operator and pressed along the side of the bowl while it automatically rotates. Keep the material in the bottom half of the bowl. Otherwise, the alginate material will splash everywhere.

- Stop and wipe off the spatula.
- Resume mixing by flexing the flat portion of the spatula blade against the center and side of the bowl until mixed.
- Collect the mixed alginate on the spatula and prepare to load the impression tray.

The Whip-Mix Vac-U-Mixer may also be used to mix alginate impression material (Figure 4). The use of this power-driven equipment insures a bubble-free mix because air is sucked from the mix by means of vacuum tubing. The self-contained mixing bowl and lid, which is attached to the machinery, will automatically mix the alginate. Refer to the manufacturer's operating instructions before using the Vac-U-Mixer.

The following steps are general guidelines:

### Steps to Use Vac-U-Mixer

- Rinse the bowl and lid assembly. A separate bowl should be used for alginates only. Shake off excess water.
- Fill the bowl with water and alginate powder according to the manufacturer's instructions.
- Hand spatulate to incorporate all powder particles into the water.
- Place the lid with paddle on the bowl and twist the lid so the tabs lock together.
- Attach the vacuum by placing the metal nozzle at the end of the vacuum hose into the opening located on top of the lid.
- Grasp the bowl and lid as one unit and insert the drive nut into the drive chuck for automatic start.
- Turn the manual switch to "ON" so the pump continues to run after the bowl is disengaged.
- The suggested mixing time is 12-15 seconds at low speed.
- Break the vacuum immediately and use mixed alginate in the conventional manner.
- Let the vacuum pump run for an additional minute to purge water vapor and allow the unit to automatically re-oil.

### Mixing Techniques

#### Mandibular Tray
Inspect all materials for cleanliness. All disinfected bowls and spatulas should be rinsed and dried before use. This removes the disinfectant residue which may become incorporated in the mix and cause an allergic reaction for the patient.

Always take the mandibular impression first. The patient is less likely to gag on the lower, thus instilling a positive experience. The following steps should be used to obtain a full mandibular arch impression:

### Steps for Mixing Mandibular Tray

- Place two measures of room temperature water into the bowl.
- Fluff the powder canister. A gentle tumble is all that is necessary. Back and forth motions are not recommended because this will condense the alginate within the container, thus disrupting the water/powder ratio.
- Place two level scoops of powder into the bowl of premeasured water.
- Stir the water and powder until all the powder particles have been moistened.
- Mix the alginate by pressing it along the sides of the bowl. Be sure to condense the mixture between the bowl and spatula to remove air bubbles and create a creamy, homogeneous mix. (As an alternative to
Press down on the posterior portion of the tray first and continue to the anterior in one smooth motion.
• Roll the lower lip up over the anterior portion of the mandibular tray for finer anatomical detail.
• Instruct the patient to elevate his tongue and then relax it. This technique enhances a more detailed duplication of the lingual aspect.
• Firmly hold the tray with equal bilateral pressure in the patient's mouth while awaiting the final set of the impression material. The firm, equal pressure on both sides of the mouth will prevent distortion (Figure 7).
• Prior to the removal of the tray, the operator must check to see if the material has set. The operator can easily test for the final set by simply pressing the alginate in the mixing bowl or in the patient's mouth with the operator's finger to observe that no deformation or dent occurs in the material.

Hand mixing, use an Alginator or a Whip-mix as previously discussed.

• Collect the mixed mass of alginate into one area along the edge of the mixing bowl.
  NOTE: The inexperienced operator may find it necessary to take a small amount of the mixed alginate and place it in the oral vestibule and/or occlusal surfaces to insure total anatomical coverage and accuracy without air bubble entrapment.
• Take half of the mixed alginate and quickly load it into the mandibular tray from the lingual aspect while firmly pressing down towards the bottom of the tray.
• Collect the second half of the mixed alginate and fill the opposite side of the tray in the same manner.
• Wet gloved fingers with cool water and pass the fingers over the tray with a light force to create a smooth finish (Figure 5).

Seating the Mandibular Tray
After the impression tray has been satisfactorily fit to the patient's mouth, utility wax may be placed around the periphery of the tray for reasons already cited. After the alginate has been mixed and the tray has been loaded, the tray is now ready to be inserted into the patient's mouth. The following guidelines should be followed for seating a mandibular tray in the oral cavity:

Steps for Seating Mandibular Tray

• Have the patient seated in an upright position.
• The operator should be positioned in front of the patient for proper seating of the impression.
• Instruct the patient to open his or her mouth.
• Opening too widely eliminates the elasticity of the cheek, which is necessary for properly seating the impression.
• Retract the cheek with your index finger to provide visibility for placement of the tray.
• Insert the tray from the side and then center it over the arch (Figure 6). The midpoint of the impression tray handle should be perfectly aligned with the patient's midline while the tray handle maintains a parallel position to the floor.
Disinfection and Storage

All impressions must be disinfected before being removed from the treatment area. The following steps should be taken:

Steps in Disinfection of Impression

- Immediately after inspection is completed, rinse the impression for thirty seconds under slow running, room temperature tap water to minimize aerosolization and splatter. Check to see that all blood, saliva, and debris has been removed.
- Spray disinfectant completely covering all areas of the impression and tray; or use the immersion method according to the manufacturer's recommendations.
- After disinfection, rinse the impression under room temperature tap water for thirty seconds.
- Place disinfected impression, wrapped in a moistened paper towel in a plastic bag for storage until poured. (Bags can be purchased commercially or headrest covers may be used.)
- Ideally, the impression should be poured in gypsum within 30 minutes to prevent dimensional distortion. Impressions may be poured in-house or picked up by a commercial dental laboratory. It is inadvisable to mail study model impressions to a laboratory. The time elapsed between the actual impression taking and subsequent pouring of the impression will result in dimensional distortion.

Removal of Mandibular Impression

All alginate impressions should be removed in one quick snap-out motion to prevent distortion of the impression. The operator should insert the index finger into the mucobuccal fold of the patient's vestibule while tucking the index finger under the periphery of the tray and push in an upward motion. This will enable the operator to break the alginate seal that conforms to the teeth while exerting a firm lifting motion with the opposite hand. The tray should be held with the operator's thumb under the tray handle and the fingers resting over the handle to prevent possible trauma to the maxillary anterior teeth (Figure 8). Exert a firm lifting uniform motion; snap the impression tray up off of the mandibular arch. Never rock or wiggle the tray to remove it from the dental arch, as this is certain to create an overall distortion of the impression.

Inspection of Impression

The alginate impression should be inspected immediately upon its removal from the oral cavity. The purpose of inspection is to observe:

- a smooth homogeneous set (a grainy appearance will show if spatulation was inadequate).
- that the impression did not separate from the impression tray.
- coverage of the total dentition and its accompanying freni and vestibular anatomy.
- presence of voids and air bubbles.
- no evidence of tray visibility in the incisal and occlusal surfaces.
- sharp anatomical detail.
- blood, saliva and debris.

Figure 7. Holding Tray in Place.
Image courtesy of Dux Dental

Figure 8. Image courtesy of Dux Dental

Figure 8.
Maxillary Tray
Once the impression tray has been satisfactorily fit to the patient's mouth, the operator should dry the trays and affix the beading wax to customize the tray prior to mixing the alginate. The maxillary impression is always taken after the mandibular impression has been obtained. The following steps should be followed to obtain a full maxillary impression:

Steps for Seating Maxillary Tray
• Have the patient seated in an upright position. The patient’s occlusal plane should be parallel to the floor.
• The operator should be positioned at the patient's side for proper seating of the impression tray.
• Instruct the patient to open his or her mouth. Opening too widely eliminates the elasticity of the cheek, which is necessary for properly seating the impression tray.
• Retract the cheek with the index finger to provide visibility for placement of the tray.
• Insert the tray from the side of the patient's mouth and then center it over the maxillary arch. The midpoint of the impression tray handle should be perfectly aligned with the patient's midline while the tray handle maintains a parallel position to the floor.
• Press down on the posterior portion of the tray first and continue to press anteriorly in one smooth motion. This will force the excess alginate material forward to obtain maximum vestibular anatomy and simultaneously eliminate the flow of alginate down the patient's throat.
• Roll the upper lip up over the anterior portion of the maxillary tray for finer anatomical detail.
• Firmly hold the tray with equal bilateral pressure in the patient’s mouth while awaiting the final set of the impression material. This firm bilateral pressure will prevent distortion of the impression. The operator should be positioned at the patient's side while maintaining a "headlock" for stability. Instruct the patient to tuck his chin downward as he tips his head forward and hold still.

Steps for Mixing Maxillary Tray
• Place three measures of room temperature water into the mixing bowl.
• Fluff the powder canister. A gentle tumble is all that is necessary. Back and forth motions are not recommended because this will condense the alginate within the container, thus disrupting the water/powder ratio.
• Place three level scoops of powder into the bowl of premeasured water.
• Stir the water and powder until all the powder particles have been moistened.
• Mix the alginate by pressing it along the sides of the bowl. Be sure to condense the mixture between the bowl and spatula to remove air bubbles and create a creamy, homogeneous mix. (As an alternative to hand mixing, use an Alginator or a Whip-mix as previously discussed.)
• Collect the mixed mass of alginate into one area along the edge of the mixing bowl. The inexperienced operator may find it necessary to take a small amount of the mixed alginate and place it in the oral vestibule and/or occlusal surfaces to insure total anatomical coverage and accuracy without air bubble entrapment.
• Take all of the mixed alginate and quickly load it into the maxillary tray from the palatal aspect while firmly pressing down towards the bottom of the tray. This technique will prevent voids and air bubbles in the impression.

Wet fingers with cool water and pass the fingers over the tray with a light force to create a smooth finish.
• The operator can easily test for the final set by simply pressing the alginate in the mixing bowl or in the patient’s mouth with a finger to observe that no deformation or dent occurs in the alginate impression material.

Removal of Maxillary Tray
Maxillary impressions should be removed in one quick snap-out motion to prevent distortion of the impression material. The operator should insert the index finger into the mucobuccal fold of the patient’s vestibule while tucking the index finger over the periphery of the tray while pulling in a downward motion. This will enable the operator to break the alginate seal that conforms to the teeth while exerting a firm downward uniform motion with the opposite hand. The tray should be held with the operator’s thumb over the tray handle and the fingers resting under the handle to prevent possible trauma to the mandibular anterior teeth. Exert a firm downward motion; snap the impression tray off of the maxillary arch. Never rock or wiggle the tray to remove it from the dental arch, as this is certain to create overall distortion of the impression.

As with the mandibular impression, the maxillary impression must then be inspected for the purposes previously cited. At the same time, guidelines for disinfection and storage should be implemented. REMEMBER: Alginate impressions must be poured within 30 minutes to avoid distortion. It should be noted that both impressions and the wax bite registration should be packaged together in one bag to avoid error.

Bite Registration
A bite registration is an occlusal representation of how the maxillary and mandibular teeth intercuspate. Bite registration is essential for the subsequent articulation of the maxillary and mandibular study models. The bite registration is routinely obtained immediately following the maxillary impression. If the bite registration is taken prior to tray selection, the registration can aid in choosing the appropriate size of the impression tray on the first selection. This time-saving technique eliminates the need for the sterilization of improperly sized trays.

Options for Obtaining the Bite Registration
The operator instructs the patient to practice opening and closing in centric relation in preparation for obtaining an accurate bite registration. There are currently a variety of ways to obtain the bite registration.

It may be accomplished via: Baseplate wax method - Baseplate wax is manufactured in 3”x 5” sheets and sold by the box. The 3”x 5” sheet may easily be cut with a lab knife to accommodate the width of the dental aches. The custom-sized baseplate wax may be cut in arch form or folded in half and used in rectangular form to increase the stiffness. It is placed in the patient’s mouth after it has been softened in lukewarm water. It is placed over the occlusal surfaces of either dental arch, depending on the operator’s preference. The patient is instructed to bite normally into the wax in centric occlusion. The patient’s teeth should remain embedded in the wax while the wax cools and hardens. The operator may choose to accelerate the cooling and hardening process by applying air from the air/water syringe. Once this is accomplished, the operator carefully removes the wax bite registration from the oral cavity while making every attempt to avoid distorting it. It is then inspected for accuracy and immediately disinfected by spraying or immersion.

Bite waxes are manufactured in the shape of the dental arch with foil sandwiched between the wax. It must be softened under hot water (Figure 9). It is placed over the occlusal surfaces of either dental arch. The patient is instructed to bite normally into the wax in centric relation. It

Figure 9. Placing Bite Wax in Mouth.
Image courtesy of Dux Dental
remains in place until it has cooled and hardened (Figure 10). Once this is accomplished, the operator carefully removes the wax bite registration from the mouth. It is inspected for accuracy and appropriately disinfected.

Elastic bite registration material is manufactured for use with cartridge delivery systems. The bite registration material is injected onto the mandibular occlusal surfaces. The patient is directed to occlude in centric relation. The material remains in place until it has achieved a rubberized state. It is then carefully removed from the oral cavity, inspected for accuracy and appropriately disinfected.

Gypsum
Gypsum is a naturally occurring mineral mined in various parts of the world. In its purest form it is known as calcium sulfate dihydrate and water. Manufacturers process the mined gypsum by heating it in kilns to temperatures between 230-250 degrees F. This procedure eliminates the water content from the gypsum, thus producing calcium sulfate hemihydrate. It is subsequently distributed for commercial use. Calcium sulfate hemihydrate is the actual mineral gypsum product used in dentistry to fabricate diagnostic study models or positive reproductions of the oral cavity. The gypsum powder, which may be plaster, stone, improved stone or investment materials is mixed with water until a smooth, creamy mix is achieved and allowed to solidify or harden into a rigid mass. The setting of the gypsum is achieved through the "Loss of gloss" phenomenon. This occurs during the initial setting of the gypsum cast between the first 7-13 minutes. An exothermic chemical reaction occurs when the shiny plaster finish takes on a dull appearance. If the operator's skin comes in contact with the plaster, he or she will feel heat, which is the result of a rise in temperature during hardening through the exothermic process. The final set of plaster takes place within 45-60 minutes. Plaster is the recommended choice of gypsum products for use in dentistry for study model construction for presentation purposes. When additional strength is a concern, stone may be used for increased durability, i.e. stone is advisable for procedures such as the fabrication of bleaching trays or mouthguards. The following are desired characteristics of gypsum products:

<table>
<thead>
<tr>
<th>Characteristics of Gypsum Products</th>
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</thead>
<tbody>
<tr>
<td>• Compatibility with impression materials</td>
</tr>
<tr>
<td>• Acceptable working and setting times</td>
</tr>
<tr>
<td>• Adequate flow properties</td>
</tr>
<tr>
<td>• Ease of manipulation</td>
</tr>
<tr>
<td>• Reasonable cost</td>
</tr>
<tr>
<td>• Adequate shelf life</td>
</tr>
<tr>
<td>• Acceptable strength and durability</td>
</tr>
<tr>
<td>• Excellent dimensional stability</td>
</tr>
<tr>
<td>• Capable of duplicating fine detail of hard and soft tissues</td>
</tr>
</tbody>
</table>

Packaging
Gypsum plaster is packaged in 25-50 pound boxes, 100 pound drums and in pre-packaged envelopes. It is imperative that gypsum powder be stored in an airtight container to prevent moisture contamination, which interferes with the set of the material. It is recommended that all gypsum products be stored in a cool, dry area in an airtight container to prolong the shelf life of the material. It should be noted that gypsum left in open containers will readily absorb moisture and humidity, which will markedly decrease the shelf-life and will adversely effect the setting properties of the material.

Setting Times
Setting time may be defined as the amount of time required from the initial incorporation of gypsum powder with water until the material hardens or sets. An exothermic chemical reaction gives off heat during the hardening of
gypsum. Placing your hand on the plaster and feeling warmth will evidence this exothermic reaction. It is recommended that once poured into the impression, gypsum should remain undisturbed for 45-60 minutes to completely set before separating the model from the impression. Although mixing bowls should be disinfected, check once again to see if any hardened gypsum is still present in the mixing bowl. Unclean bowls will adversely effect the setting times, the consistency and the overall strength of the gypsum material.

Gypsum setting times may be influenced by the use of accelerators and retarders.

The following are examples of accelerators that hasten the set of gypsum:
• Increase in water temperature above 68 degrees F when mixing the plaster
• Increase in room temperature or humidity
• Faster rate of spatulation time will hasten the setting time
• Pinch of table salt (sodium chloride)
• Decrease the amount of water specified by the manufacturer

The following are examples of retarders that allow for more working time and increase the setting time:
• Cooler than room temperature water
• Decrease in room temperature and humidity
• Slower rate of spatulation will slow down the setting time
• Borax (calcium salts) in small concentrations
• Increase in the amount of water specified by the manufacturer, although this weakens the cast

Properties of Dental Plaster Powder
Dental plaster or Plaster of Paris powder particles are jagged and irregular in shape, porous, and vary in particle size. Plaster is usually white, which is desirable for presentation purposes. It should be stated that dental model plaster is the weakest of all dental gypsum. Therefore, care must be taken when handling study casts during consultations. The operator must protect himself when handling gypsum products by wearing Personal Protective Equipment (PPE). Prolonged exposure may lead to respiratory problems and eye irritation. MSDS should be reviewed prior to handling the product while paying close attention to the Health Hazard Data section.

Armamentarium/Supplies and Equipment
The following supplies and equipment are necessary for pouring impressions for study model construction:

<table>
<thead>
<tr>
<th>List of Supplies &amp; Equipment Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Impressions</td>
</tr>
<tr>
<td>• Room temperature water</td>
</tr>
<tr>
<td>• Water measuring device</td>
</tr>
<tr>
<td>• Model plaster powder</td>
</tr>
<tr>
<td>• Powder measuring device</td>
</tr>
<tr>
<td>• Flexible rubber mixing bowl</td>
</tr>
<tr>
<td>• Stiff bladed spatula</td>
</tr>
<tr>
<td>• Laboratory vibrator to be covered with clear plastic bag for clean up purposes</td>
</tr>
<tr>
<td>• Bracket tray cover for workbench cleanliness</td>
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<tr>
<td>• Model base accessory items, i.e. boxing wax, prefabricated base formers</td>
</tr>
<tr>
<td>• Tiles for inversion technique</td>
</tr>
<tr>
<td>• Laboratory knife</td>
</tr>
<tr>
<td>• PPE for operator</td>
</tr>
</tbody>
</table>

Lab Preparation of Impression
• Remove moist paper towels from alginate impression.
• Remove moist cotton rolls from occlusal and incisel areas.
• Gently shake the impression over the lab sink in order to remove excess moisture.
• Spray the impression with a commercially manufactured debubblizer. This serves to reduce the surface tension, thereby enhancing the flow of the plaster and reducing the number of air bubbles on the cast's surface.
• Gently air-dry the impression.
• Inspect impression to confirm that all obvious moisture has been removed.

Gypsum Hand Mixing Technique
It is important to follow the manufacturer’s instructions for water/powder ratios. The use of a Whip Mix Vac-U-Mixer eliminates the need for hand mixing. (The Alginator may also be used for mixing gypsum provided great care is taken to
avoid splashing.) The generally recommended W/P ratio for hand mixing is usually 50:100 or simply phrased, one-part water to two-parts powder. An example of this W/P ratio would be 1/2 cup of water to 1 cup of powder. Dental plaster is mixed with water to obtain a creamy, homogeneous consistency. The following list outlines the steps to be followed for successfully mixing plaster by hand:

### Steps for Mixing Gypsum by Hand

- Assemble all armamentarium, supplies and equipment.
- Place premeasured, room temperature water into the clean mixing bowl.
- Measure twice as much plaster powder as used for water.
- Gradually sift/add powder into water to prevent air entrapment.
- Allow the wetting of powder particles.
- Stir the powder and the water together.
- Hand spatulate the mix at 120 RPM for one minute in one continuous direction to avoid air entrapment. As always, the manufacturer's instructions should be strictly followed.
- Place the bowl of mixed plaster on the platform of the vibrator that has been covered with plastic.
- Secure the bowl and mix with one hand while turning the vibrator on "low" speed.
- Press the sides of the flexible bowl on the vibrator while observing for the release of air bubbles. If bubbles fail to break from vibration, it may be necessary to mechanically break the bubbles with the spatula.
- Once this has been accomplished, remove the bowl from the vibrator for subsequent pouring.

### Pouring the Anatomical Portion of the Study Models

The anatomical portion of the study model is always poured prior to the base/art portion of the cast.

**Leaving the vibrator on low speed**, the operator will proceed with the following steps:

- Hold the impression by the handle while resting the base of the impression tray at an angle on the vibrator's platform (Figure 11).
- Load the tip of the spatula with a small amount (approximately 1/2 teaspoon) of mixed plaster.
- Start to fill the impression by resting the spatula against one posterior corner (Figure 12).
- Allow the mix to flow into the occlusal surfaces of the adjacent teeth.
- Continue to add small increments of mixed plaster to the same corner as the first increment of plaster. Observe the plaster as it flows down into the occlusal and incisal surfaces.
- Rotate the tray sideways to force the flow of material into each tooth impression.
- Once all teeth have been sufficiently filled with plaster, add larger increments of mix until the entire impression is filled. Vibrate a few more seconds.
• Remove impression from the vibrator.
• Turn off the vibrator.
• The study model will begin to set slightly while the operator prepares the base/art portion material for the study model.

Creating the Study Model Base/Art Portion
The base of the study model may be referred to as the art portion of the cast. This area should not exceed 1/3 of the overall height of the cast. The purpose of the study model base is for:

• Aesthetics - adds to the professional appearance of the models.
• Articulation - to properly represent the patient's occlusion and relative anatomical structures.
• Preservation - for ease in handling and storage.

The base/art portion of the cast can be produced through one of the following methods:

**Inverted technique:** A separate mix of gypsum is made with a W/P of 2:5 using the conventional mixing technique already outlined for pouring the anatomical portion impression. This increased W/P provides a thicker mix and stronger model base. A mass of material is placed onto a ceramic tile approximately 1 inch in height. The diameter of the mass should exceed the circumference of the impression to allow for subsequent trimming of the base with appropriate angles. Invert the impression tray or anatomical portion of the cast and place over the (gypsum mass) base material. Using a stiff, wet spatula, mold the plaster to the initial pour, making certain not to imbed the tray in plaster (Figure 13). Be sure to add plaster to the heels of the base. The handle should maintain a parallel position to the countertop. Leave undisturbed for 45-60 minutes to allow complete setting of the plaster.

The base/art portion of the cast can be produced through one of the following methods:

**Rubber model base former:** A separate mix of gypsum is made with a W/P of 2:5. With the vibrator on low and the rubber base former resting on the vibrator platform, fill the commercial base former with plaster. Invert the initial pour onto the gypsum in the mold making certain that no voids exist between the initial pour and the base material. The advantage of using a model base former is that it eliminates time-consuming model trimming.

**Boxing method:** Boxing wax is used to create a wall around the circumference of the unpoured impression to create one unit to be poured. First, the anatomical portion of the impression is poured. Subsequently, the operator continues to fill the gypsum material to the top of the boxing wax. The boxing wax acts like a retaining wall to support the art portion of the cast created in this manner. This wax wall eliminates the need for inverting the poured impression to create a base.

**Maxillary & mandibular base former with handle slot:** The base is obtained by placing the handle of the impression tray into the base former (Figure 14). A notch in the base former allows the handle to sit in the former. The impression tray fits snugly inside the former. It is then filled with gypsum in the conventional manner.

![Figure 13. Poured Impression on Base.](Image courtesy of Dux Dental)

![Figure 14. Standard Base Formers.](Image 72x123 to 299x277)
Separating the Cast from Impression
The operator should carefully remove the impression tray from the plaster cast without deformation to the model. This is accomplished by placing a laboratory knife between the abutting gypsum and the tray periphery. Next, the knife is gently twisted to loosen or separate the cast from the alginate. The tray is then lifted off in one upward motion. Never rock the tray off the cast as this motion may easily lead to breakage of the teeth (Figure 15).

In the event that the cast does not separate easily from the alginate, recheck the peripheral margins and resume using the knife to gently pry the stubborn area. This situation occurs if the impression was overpoured or overseated during inversion. If concern for breakage is evident, soak the cast in cool water for 10 minutes. This will ease the model separation process.

Trimming the Cast
The purpose of trimming study models is to articulate the maxillary and mandibular arches in occlusion. The models are then ready to sit in proper occlusion for presentation, preservation and storage purposes.

Ideally, study models should be trimmed with a model trimmer (Figure 16) immediately after their separation from the alginate impression tray. The study model should be wet to enhance the ease of cutting the angles of the base on the model trimmer. If several hours have passed from the time of model separation from the alginate impression, it may be necessary to submerge the study models under cool water for 10-15 minutes. A dry model will bind in the model trimmer and leave stone on the cutting wheel. To enhance the professional appearance of the cast, flick off any imperfections from the moist models by using a small lab knife. Generally speaking, for a Class I or a Class II malocclusion, the maxillary cast is trimmed first. Subsequently, the mandibular cast is set into occlusion by means of the wax bite registration and trimmed to conform to the maxillary cast. It is recommended to trim the mandibular cast first in the presence of a Class III malocclusion. Note: As always, safety first, i.e. all PPE should be worn by the operator during this procedure. Special attention should be given to protect the eyes and the hands during the operation of the model trimmer as well as disinfection of the treatment area and sterilization of any instruments used during the operation of the model trimmer.

The following procedures should be followed for trimming casts:

**Steps for Trimming Casts**

- Place the base of the maxillary model on the table of the model trimmer, which is preset at 90 degrees.
- Turn the water to the model trimmer on. Moderate water flow will enable the rotating wheel to cut easier, as well as clean itself. Then, turn model trimmer to the “ON” position.
- Gently press the base of the cast on the rotating wheel. The base is trimmed parallel to the rotating wheel.
• Articulate the maxillary and mandibular cast to the occlusal plane. Continue applying light force until the base comprises 1/3 of the overall height of the cast. The anatomical portion will comprise the remaining 2/3 of the entire cast. This can be determined by the use of a flexible millimeter ruler by measuring the maxillary model from the base of mucco-labial fold to the cusp tip of the canine. The total height of the maxillary cast should be 35 mm. The total height of the mandibular cast will also be 35 mm. The combined overall height of the diagnostic casts will be 70 mm or 2.75 inches in height according to the old Tweed method. The new Tweed, which stands at an overall height of 2.5 inches, may be the practitioner’s preference. Repeat the same procedure for the mandibular base. (Figure 17)

• Place the base portion of the maxillary cast on the platform of the model trimmer. Apply light force to cut the heel of the model perpendicular to the midline. (Figure 18)

• Remove the cast from the model trimmer and examine it to see if it sits flat (180 degrees) when placed on the workbench.

• Hold the side of the maxillary cast on the wheel and trim each side at 65 degrees from the heels. Allow 3-5 mm of space beyond the facial surfaces of the teeth on the cast.

• Trim the anterior portion of the maxillary cast to form a point at the midline. This should configure to an 85 degree angle. This point will be approximately 5 mm from the labial surface of the maxillary central incisors. The end point should run from canine to canine (Figure 19).

• While trimming the anterior angles, it is imperative to leave all of the natural anatomical structures intact, i.e. frenum, vestibular area etc. The anterior cuts should follow the general contour of the anterior teeth, be of equal length, be at the same angle to the sides of the model, be cut to the greatest depth of the vestibule without cutting into the anterior teeth and end anteriorly at the midline of the maxillary arch.

Figure 17. Height of Cast.
Image courtesy of Dux Dental
study models with a fine grit sandpaper under slow running water. **NEVER** sand the teeth or anatomical structures of the casts. The models may now be polished to a high gloss finish to enhance their professional appearance. This may be accomplished through the use of a commercial model luster spray or submersion in a model luster solution for one hour. An alternative to using a commercial model luster product is to entirely submerge the casts in a soapy solution of Ivory flakes and hot water (165 degree F) for one half hour. Finally, buff each cast with a soft, dry, clean cloth to achieve a high glossy appearance.

**Labeling and Storage**

Each cast must be identified with the patient's full name, the date the impressions were taken and the patient's date of birth. This may be accomplished with an adhesive label that is typed and placed on the heels of the maxillary and mandibular casts 24 to 48 hours after the final finish. Another labeling device is an engraving marker. The patient's engraving information should be completed on the heels of the unfinished maxillary and mandibular casts, i.e. Prior to the soaping or luster process.

Diagnostic study models are stored on their bases in labeled boxes. Foam, sponge or bubble pack should be placed between the maxillary and mandibular cast to prevent breakage of the models.

**Summary**

Be sure to tightly reclose the storage containers that hold the alginate and gypsum products. **REMEMBER,** humidity, high temperature, moisture contamination and leaving the containers open will markedly decrease the materials shelf life thus, resulting in additional expenditures and increase overhead costs to the facility. Improper storage also adversely effects the setting qualities of these materials. All used equipment should be cleaned and appropriately disinfected prior to being stored. Always follow OSHA recommendations for decontamination. Laboratory sinks should be equipped with a plaster trap to prevent clogging or back up of the drainpipes. All unused set materials must be discarded in the trash barrel and should never be allowed to enter the sink area. All countertops should be cleaned and disinfected. Floors should be swept and the area should reestablish its neat orderly appearance.

**Finishing the Cast**

Fill in any visible voids or bubbles on the model surface with a thick mix of plaster and smooth with the gloved fingertip. Let the models dry for 48 hours. Sand the base and sides of the

**Figure 18.** Trimming Heel of Cast.
*Image courtesy of Dux Dental*

**Figure 19.** Articulated Models.
*Image courtesy of Dux Dental*

**Figure 20.** Trimmed Models.
*Image courtesy of Dux Dental*
To receive Continuing Education credit for this course, you must complete the online test. Please go to www.dentalcare.com and find this course in the Continuing Education section.

Course Test Preview
1. An alginate impression is an example of a _______________.
   a. positive reproduction
   b. working model reproduction
   c. negative reproduction
   d. reversible reproduction
   e. rigid reproduction

2. A water temperature of 80 degrees F will _______________ of an alginate mix.
   a. increase the setting time
   b. not affect the working time
   c. not change the setting time
   d. decrease the setting time
   e. increase the working time

3. Imbibition in an alginate impression occurs when _______________.
   a. water evaporates from the impression
   b. the mix changes colors
   c. excess moisture is absorbed by the impression
   d. adhesives are prematurely applied to the impression tray
   e. the mixing time is increased

4. Alginate impressions may be disinfected by _______________.
   a. spraying the alginate with glutaraldehyde
   b. submersion in phenol compounds for 20 minutes
   c. wetting with isopropyl alcohol
   d. spraying with an intermediate level disinfectant
   e. immersion for 10 minutes and leaving to air dry

5. Alginate impressions should be removed _______________.
   a. with a gentle rocking movement
   b. using one quick, snap out motion
   c. by twisting the tray sideways
   d. by unseating the lingual aspect first
   e. using a vigorous back and forth action

6. The _______________ portion of the maxillary tray should be seated in the mouth first.
   a. facial
   b. anterior
   c. posterior
   d. right side
   e. left side

7. Alginate trays should be fitted to the patient's mouth to _______________.
   a. cover the maxillary tuberosity
   b. cover the retromolar pad
   c. cover the height of anterior and posterior teeth
   d. A and B
   e. A, B and C
8. Placements of utility/rope wax on maxillary alginate trays will _________________.
   a. maximize anatomical coverage in vestibular and freni areas
   b. stop alginate from entering the retromolar area
   c. prevent alginate from flowing down the throat
   d. A and C
   e. A, B and C

9. ________________ would accelerate or hasten the set of dental plaster.
   a. A water temperature of 60 degrees F
   b. Using more water than powder
   c. Adding a pinch of table salt
   d. A slow rate of spatulation
   e. Incorporating borax into the mix

10. When taking a wax-bite registration, the patient is directed to _________________.
    a. bite with the posterior teeth first
    b. close normally in centric occlusion
    c. occlude with lateral movements
    d. bite with the anterior teeth first
    e. close quickly and apply vigorous force

11. It is recommended that the ____________ alginate impression be taken first.
    a. mandibular
    b. maxillary
    c. operator's choice

12. ____________ is the term used to describe the chemical reaction that occurs when gypsum gives off heat during the initial setting phase.
    a. Syneresis
    b. Colloidal conversion
    c. Irreversible
    d. Exothermic
    e. Thermoplastic

13. When plaster is poured into the teeth of the alginate impression, the W/P ratio should be __________ part(s) of water to __________ part(s) of powder.
    a. 2:2
    b. 2:3
    c. 1:3
    d. 1:2
    e. 2:1

14. The removal of air bubbles from a plaster mix may be accomplished by _________________.
    a. manually breaking with a spatula tip
    b. vibrating the material
    c. stirring the mix in one direction
    d. sifting the powder into the water
    e. All of the above.
15. Models/casts should be ____________ before trimming takes place on a model trimmer.
   a. air dried
   b. debubblized
   c. soaked in cool water
   d. wiped with alcohol
   e. soaped

16. When separating the model/cast from the impression, ________________.
   a. wiggle the tray up off the cast
   b. use rocking lateral movements
   c. soak the tray and model in a separating medium
   d. tap the tray with the knife handle to loosen it
   e. pull the tray handle up in one motion

17. The anterior base (art portion) of a mandibular model/cast is trimmed into a _________ shape.
   a. squared
   b. rounded
   c. pointed
   d. rectangular
   e. angled

18. In general, ______ scoops of alginate powder are used for the maxillary full arch impression and ______ scoops are used for the mandibular full arch impression.
   a. 3:2
   b. 2:3
   c. 3:3
   d. 2:2

19. ____________ wax may be added to alginate impression trays to customize the fit of the tray for the patient’s needs.
   a. Baseplate
   b. Boxing
   c. Sticky
   d. Utility/rope
   e. Hard

20. Alginates are classified as ____________ impression materials.
   a. rigid
   b. reversible
   c. elastic
   d. solid
   e. thermoplastic

21. "Loss of gloss" is a term used when referring to the setting of ____________.
   a. alginate
   b. plaster
   c. wax-bite
   d. A and B
   e. A, B and C
22. Gypsum material requires an undisturbed setting time of __________ after it has been poured into the impression.
   a. 15-25 minutes
   b. 30-40 minutes
   c. 45-60 minutes
   d. 65-90 minutes
   e. 95-120 minutes

23. If alginate was mixed within the appropriate working time, yet it was too thick to be seated in the patient's mouth, you should _________________.
   a. use cooler water (below room temperature)
   b. check the W/P ratios to be sure too much powder was not used
   c. spatulate for a longer amount of time
   d. add a pinch of salt to the mix
   e. A and B

24. ________________ may help to alleviate the gag reflex when taking alginate impressions.
   a. Remove the tray from the mouth as soon as it has set
   b. Do not overload the posterior regions of trays
   c. Present yourself with confidence
   d. Have the patient take deep breaths through the nose
   e. All of the above.

25. The anterior angles of the maxillary casts should be trimmed from _________________.
   a. first premolar to first premolar
   b. second premolar to second premolar
   c. lateral incisor to lateral incisor
   d. canine to canine
   e. first molar to first molar

26. The patient should be seated in an upright position when taking alginate impressions.
   a. True
   b. False

27. The alginate impression should be disinfected _________________.
   a. in the laboratory
   b. prior to shipment to the laboratory
   c. before leaving the treatment area
   d. whenever the operator has time
   e. it is not necessary provided the impression has been thoroughly rinsed

28. Using too much water when mixing gypsum results in _________________.
   a. a thinner mix, but a stronger model
   b. a thinner mix and a weaker model
   c. a thicker mix, but a stronger model
   d. a thicker mix and a weaker model
   e. no significant difference
29. The time allotted for mixing the alginate, loading the impression tray and seating the tray in the patient's mouth is referred to as ____________.
   a. spatulation time
   b. setting time
   c. finishing time
   d. loading time
   e. working time

30. All the following are examples of acceptable trays used to fabricate diagnostic study models, EXCEPT ____________.
   a. perforated trays
   b. metal trays
   c. quadrant trays
   d. disposable trays
   e. styrofoam trays

31. When mixing gypsum products, the ____________ is poured into the ____________.
   a. water: powder
   b. powder: water
   c. Doesn't matter.

32. Incomplete set or a grainy set of gypsum and alginate products may be the result of ____________.
   a. expired shelf life
   b. humidity
   c. improper storage
   d. insufficient spatulation
   e. All of the above.

33. The following acceptable alternatives for manual mixing of alginate and gypsum products include a/an ____________.
   a. Amalgamator
   b. Alginator
   c. Model trimmer
   d. Vac-U-Mixer
   e. B and D

34. Impression inspection includes ____________.
   a. the presence of retromolar area and maxillary tuberosity
   b. a smooth, homogenous set
   c. sharp anatomical detail
   d. a surface free from voids
   e. All of the above.

35. The art portion of the study model should be trimmed to a height that is not greater than ____________ of the overall height of the model.
   a. 1/2
   b. 1/3
   c. 1/4
   d. 1/5
   e. 1/6
References

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Ms. Gambardella is the director of Dental Assisting at the Minuteman School of Applied Arts and Sciences and Adult Career Center in Lexington, MA. A frequent speaker at dental conferences, Ellen has given numerous presentations nationwide that are noted for their holistic approach to learning. She has served as a faculty member for Tufts and Northeastern Universities and Middlesex Community College Dental Science Departments.

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Ms. Johnson is a Dental Associate/Treatment Coordinator in Medford, Massachusetts as well as Professor of Dental Science at Middlesex Community College, Lowell, MA, where she was the recipient of the Outstanding Adjunct Faculty Recognition Award of 1997. A noted speaker, Rita has an extensive background lecturing to special interest groups and a wide variety of audiences including Harvard University School of Dental Medicine. Ms. Johnson serves as a member on Educational Advisory Boards, designs dental curriculums, has vast experience in the area of practice management, and is a noted specialist in the field of Orthodontics.

Ellen Gambardella and Rita Johnson are the founders of Dynamic Dental Seminars and Consulting Services, P.O. Box 1008, Concord, MA. 01742. Their combined expertise offers students more than 50 years of experience in the dental arena.