

**M. Payne**

## **Preparing Teeth for Bonding**

This module will educate you on the concepts of tooth preparation to bond orthodontic brackets and to restore teeth. You will understand and effectively demonstrate the sequence of steps, patient management, and the different materials used to effectively prepare teeth for the bonding of brackets.

### **Syllabus content**

- I. Understanding the factors for bonding success
- II. General concepts in bonding to enamel surfaces
- III. Armamentarium
- IV. Patient Assessment and Education the Patient for Bonding
- V. Isolation and Moisture Control
- VI. Acid etching
- VII. Acid etch removal
- VIII. Rinsing tooth surfaces
- IX. Drying tooth surfaces
- X. Application of bonding primers and resins
- XI. Preparing dental restorative material surfaces for bonding

Successful bonding technique is an absolute necessity in orthodontics and a very important skill for every orthodontic assistant. The concepts related to bonding to enamel of adults and children, as well as the variations in bonding required for gold crowns, porcelain crowns and resin or plastic materials utilized in dentistry is essential. The goal of tooth preparation is to create an optimum surface to attach brackets to the teeth utilizing bonding materials. Well bonded brackets remain in place despite everyday chewing and functioning. Broken brackets lead to clinical inefficiency, emergencies which negatively affect the schedule, as well as inconveniences to patients and parents. With a thorough understanding of bonding, you will avoid pitfalls that lead to bracket failures.

### **I. Understanding the factors for bonding success**

What are the important factors in effective bonding of orthodontic brackets to teeth?

**The Orthodontic professional-** Your ability-, understanding of the processes, and attention to detail will assure brackets have adequate bond strength to hold the brackets in place during normal incising and mastication. Of all the factors resulting in bond failures, technique is the most critical factor and the one that you can control.

**Materials-** A great deal of research and development has focused on designing better bonding materials to effectively bond brackets to tooth surfaces. The critical factor in achieving a strong bond still remains the knowledge and skill of the operator in properly utilizing these materials. Consistency and repetition have shown to reduce errors in execution.

**Location-** The ease of isolating certain teeth and the adverse effects from the oral environment varies depending where in the mouth you are preparing a tooth for bonding. Can you easily apply etching agents? Is the tooth more likely contaminated by saliva or debris from a cheek or seepage from the gingival crevice of a short tooth? Is the tooth more highly mineralized with proximity of the salivary ducts which bathe the surface of the tooth with more minerals?

**Clean material surface-** In order to create an effective bond, you must start with a clean surface. You cannot effectively bond to a surface laden with surface debris, calculus, plaque, blood, or saliva. Understand and be able to identify a pristine tooth surface.

**Patient-** Is the patient cooperative and is it easy to access all the teeth scheduled for bonding? Do they have excess saliva or tight lips or cheeks limiting access to the tooth surfaces? Are they more likely to contaminate a prepared tooth surface with saliva or contact with an active tongue or cheek?

## **II. General concepts in bonding to enamel surfaces**

The goal of preparing teeth for bonding is to create a material surface which will **mate** chemically with bonding materials that are placed on the bracket bases. The common element in the composite materials used to adhere brackets to teeth is made of a resin chemical structure. This resin is present in the bracket bonding composite and also in the unfilled resin known as the bonding agent, primer, or bonding resin. Another goal is to create a **thin** surface layer of bonded resin on the tooth that is tightly bound and sealed. This can be achieved by pressing the bracket gently against the tooth to allow excess material to be extruded. This layer of material will in turn chemically bond to the material that is applied to the orthodontic bracket since it is made of the same or a similar material. No matter whether the tooth surface is composed of gold, porcelain, plastic, or enamel, the goal is the same, to end with a surface layer of bonding resin that will bond chemically to the material placed on the back of the bracket.

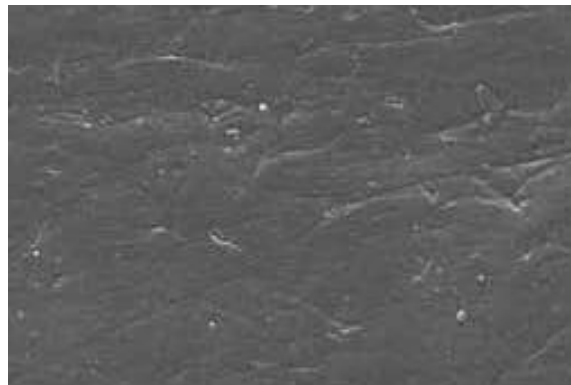


Figure 1 an unprepared enamel surface.

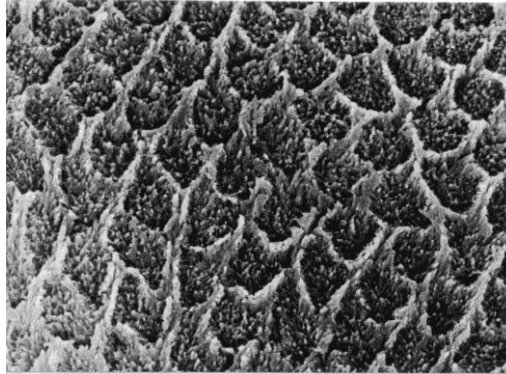


Figure 2 Enamel surface etched with 37% phosphoric acid

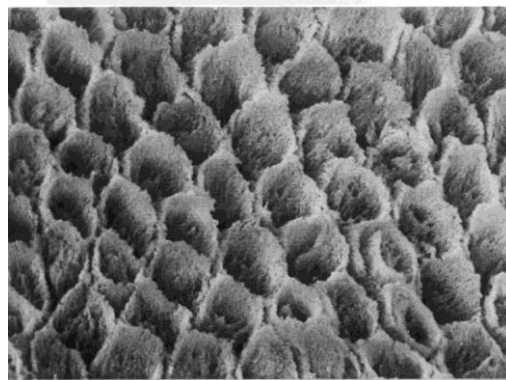


Figure 3 Enamel surface etched with 37% phosphoric acid

### **Mechanism of Bonding to Enamel**

The idea of using phosphoric acid on dental surfaces was first introduced by Buonocore (1955), who observed that adhesion to metal surfaces by paints improved when acids were used to etch the metal surface increasing the strength of the bond. An unprepared enamel surface is a poor surface to bond with mechanically or chemically which leads to poor adherence of the brackets. (Figure1). Placing an acid on the enamel surface changes the surface of the enamel by dissolving some of the calcium salts increasing the number and size of microscopic depressions (Figure 2 and 3). The liquid resin found in orthodontic bonding agents penetrates into the depressions and over the projections left from the etching process. Once the bonding agent is cured typically with a light curing unit, these fingerlike projections of resin are tightly bound to the enamel surface. The surface of the enamel is now covered with a thin resin which chemically bonds to the more viscous (thicker) composite bonding materials placed on the back of the brackets. Since the mechanical lock of the resin into the enamel is critical, proper preparation and protection of this prepared enamel surface is critical to successful bonding of brackets.

### **Acid Etchants**

No alternative that has yet been tested is as efficient and as effective as phosphoric acid for etching tooth structure. Phosphoric Acid etchants come in two basic forms, a viscous, thick gel and in a liquid. The acid etchants are either clear or colored to easily identify on

the tooth surface. There are advantages to gel etchants as these can more easily be controlled and remain where originally placed on the tooth. The etchant's main component is phosphoric acid in a 10-50% strength with 37% a common strength used in orthodontics. Compared to a neutral PH of 7 a 37% concentration of phosphoric acid is over a 1,000,000 times more acidic. The acid dissolves the calcium salts from the tooth when in contact with the tooth for 20-60 seconds. If 30 seconds is the optimum time to etch the tooth surface opening the crevices for the resin to fill; is tripling the etch time better? In fact, extending the time of the acid etch on a typical enamel surface actually reduces the bond strength. As the acid remains in contact with the tooth beyond the optimum time more calcium salts are dissolved which end up filling the crevices with additional debris thus reducing the places the liquid resin can flow into and shortening the resin tags which give the bond strength.

### **Acid Etchant Precautions and patient safety**

Phosphoric Acid etchants are a moderate strength acid. Etchant dangers should be understood by all dental staff members who use these materials as well as the precautions and means by which to mitigate the effects to the gums and mucosal tissues.

1. All dental staff should wear gloves when handling these materials.
2. Patient precautions should include methods to isolate skin, oral mucosa, and the eyes from accidental contact with etchant.
3. Avoid contact with the eyes with the use of safety glasses. Avoid passing items over the patient face.
4. The longer the etchant is in contact with tissue the greater the damage from the acid.
5. Remain vigilant and watchful of where the acid etchant is placed and practice good isolation in the oral cavity to limit contact of the acid etchant with oral mucosa.
6. If the etchant comes in contact with the oral mucosa or the eyes, immediately rinsing with water.

**Review the MSDS for the etchant and bonding materials.**

**III. Armamentarium-** A list of typical materials and instruments is included. Different offices will vary their procedures and can subtract or add additional materials they find helpful in successful bonding.

1. Prophy paste- pumice without fluoride
2. Prophy angle and slow speed handpiece
3. High speed drill ( for use by orthodontist when indicated for surface preparation)
4. High speed evacuation and tip
5. Air water syringe and tip
6. Saliva ejector and tip
7. Mouth Mirror
8. Scaler or explorer
9. Lip retractors
10. Tongue guard and saliva ejector assembly
11. Short and long cotton rolls
12. 2 x 2 gauze
13. Dry angles
14. Individual brushes/ applicators
15. Liquid wells or disposable sheets for dispensing agents
16. Acid etchant in bottle or syringe
17. Bonding agent/primers
18. Additional etchants and primers for bonding to dental restorations



#### **IV. Patient Assessment and Educating the Patient for Bonding**

Take the time to examine your patient and plan for the best techniques to isolate the teeth for bonding. Assessing your patient will give you valuable information before you decide how best to manage their bonding experience. This step also allows you to discuss what you are planning before you start and prepare them for how they can best help.

##### **1) Patient assessment**

1. Examine the patient to anticipate challenges in the bonding process. Some patients have small mouths and taunt tissues increasing the methods necessary to control the oral environment from contamination.
2. The patient assessment should answer a number of questions:
  - a. Does the patient produce an excessive amount of saliva? The average person can produce up to 1.5 liters of saliva in 24 hours produced predominantly from the parotid glands in the cheeks and the submandibular glands in the floor of the mouth. Many times it appears the 1.5 liters is flowing all at one time!
  - b. Does the patient have an active tongue and excess head movement?
  - c. Are the lips and cheeks loose or taunt and is access to the labial surfaces of the teeth difficult?
  - d. Are the vestibules deep and will these areas accommodate a cotton roll and maintain the cotton rolls without the muscles dislodging these isolation aids?

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#### **V. Cleaning tooth surfaces**

1. The oral cavity is replete with microorganisms, debris, salivary pellicle, and bathed with serous and mucous fluids. These materials accumulate on the tooth

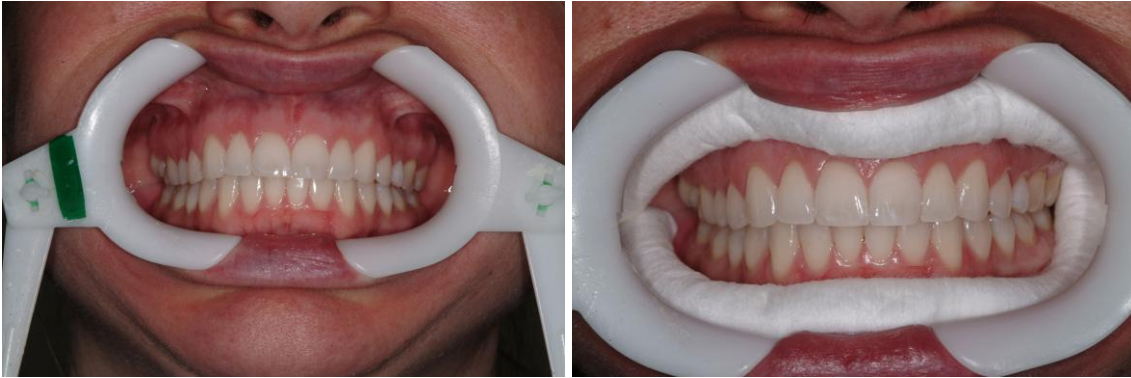
- surface. You cannot reliably etch and bond to a debris laden surface. Recognize that acquired coatings are present on the tooth surfaces and may affect bond strength. These materials should be removed prior to preparing the tooth for bonding.
- a. Salivary Pellicle- a clean tooth surface is quickly coated with salivary proteins and glycoproteins forming a very thin layer. This protein layer easily reforms when the surface of the tooth is in contact with saliva
  - b. Dental plaque- the plaque is made up of inorganic compounds, bacteria, other microorganisms, and salivary constituents
  - c. Calculus- bacterial plaque can become mineralized forming hardened deposits which are not easily worn away.
2. Cleaning the tooth surface is designed to provide a bare enamel surface on which to bond brackets. Prophylaxis of the enamel surfaces removes plaque, food particles, and some surface minerals.
- a. The surface of the tooth can be cleaned with an abrasive applied manually with a hand instrument and prophylaxis cup or more efficiently with a slow speed hand piece and prophylaxis angle, micro-etcher.
  - b. The prophylaxis paste for orthodontics is composed of pumice in a glycerin liquid for ease of application. **Fluoride or other additives** are not components of orthodontic prophylaxis pastes as these can inhibit bonding.
  - c. Once the surfaces are pumiced and the mouth is thoroughly rinsed, inspect the tooth surfaces with a scaler or explorer for residual plaque or calculus. If calculus is found the area will need scaling to expose clean enamel surface for etching and successful bonding.

**Examples of prophylaxis angles, scalers, hand instruments, active picture of prophylaxis material**

**VI. Isolation and moisture control** – once the surface of the teeth have been rinsed, dried, and thoroughly inspected for residual plaque and calculus the teeth are ready for isolation in preparation for etching. The isolation of the teeth serves a number of functions:

- a. Utilizing isolation materials creates a barrier which partitions the oral mucosa avoiding contact with the teeth.
- b. Isolation the soft tissue gives better visualization of the teeth and lessens the chance of mucosa contacting the etchant materials applied to the teeth.
- c. Placement of cotton products and shields helps control saliva and reduces the challenge of protecting the tooth surface from recontamination with saliva and salivary pellicle.
- d. A properly placed cotton roll or retractor can free an operators hands and focus back to preparation of the tooth for bonding.





### Materials for isolation and moisture control

1. Cotton roll isolation is effective in some patients to retract the cheeks and lips.
  - a. Select the cotton roll lengths that will best fit and remain in the vestibule.
  - b. In some patients (many children) the vestibule is not deep enough to passively hold the cotton roll. When you place it, a short time later you will see that it has migrated from the mucosa to the tooth level.
  - c. Longer cotton rolls sometimes work best and an extra mouth mirror may be used to hold the cotton roll in place.
2. Cheek retractors are available from a number of manufactures to retract the lips and cheeks.
  - a. Retractors can free the hands from continually holding a mirror to retract the cheek or lip.
  - b. Retractors are designed =either as a universal size or scaled for the size of the patient. Consider a child size retractor for small children as this will provide a more comfortable experience.
  - c. Some retractor designs include optional tongue guards as well as saliva ejection tubing..
3. Dry angles can also assist with moisture control from the parotid salivary ducts (Stensen's ducts adjacent to the maxillary first molars).
4. Auxiliary saliva ejectors can prove helpful for patients with excessive saliva production.
5. High Speed Evacuation - routinely we utilize high speed evacuation to suction the majority of the saliva from the oral cavity as well as to remove etchant and water spray. To reduce etchant from dispersing throughout the mouth, first suction excess etchant and then rinse/suction.
6. Some orthodontists also use anti-sialagogues such as Pro-Banthine to control saliva flow. These medications given typically in pill form 15 minutes prior to a bonding appointment shut down saliva flow drying the mouth substantially. These medications have side effects and there are patients with medical conditions which prevent there use. Only the orthodontist should prescribe or provide these medications after thorough evaluation of the patient's medical history. Considering the many systems for retracting the lips and suctioning of saliva, antisialagogues (medications which reduce salivary flow) are not needed in most patients.



**Acid Etchant placement-** once the patient teeth have been thoroughly cleaned, inspected and isolated the operator is ready to etch the tooth enamel surface.

1. If using a syringe delivery for the first time, dispense a small amount of **etch** from the application syringe to prevent any etchant gel spurting out into the patient's mouth due to air or solids lodged in the application syringe tip.
2. Dry the tooth surface then apply **etch** to the enamel covering an area larger than the bracket base and in the area where the bracket will be placed. Cover the area thoroughly while avoiding excess amounts which may slough or if overly thick may come in contact with the patients soft tissues.
3. If using liquid etchants, be very careful with placement to avoid excess amounts which may flow off the tooth and onto vital structures.
4. When using etchants, avoid excess amounts over areas of the tooth where the bracket will not be bonded, for example the interproximal areas of the teeth. Coverage of the general area of the tooth where the brackets are to be placed is permissible as it will not harm the tooth. These etched areas will remineralize especially if patients utilize fluoride rinses as recommended.
5. With gel etchants the goal is to cover the tooth surface while limiting a buildup of etchant in thickness. A thick ball of etchant will not increase the effectiveness of the etching process, wastes material, and will increase the likelihood the etchant will contact the cheek, lip, or tongue. Excess etchant can transport to areas of the mouth in quantities that can cause chemical burns to the tissue if left unidentified for an extended period of time.

### **Time factors**

1. 37% phosphoric acid is the standard etchant material from which the recommended time for etching teeth is derived. Most manufacturers recommend 15-30 seconds etch time for an average enamel surface.
2. While 15-30 seconds is average, increasing the time to a few minutes does not improve bond strength, it actually will reduce bond strength as the calcium salts from the extended etching time clog the enamel surface limiting penetration of the bond resin into the tooth.
3. Etching time should be increased in specific circumstances:
  - a. Primary teeth- the enamel structure of the primary teeth is not as consistent as that of the adult teeth.
  - b. Some orthodontists recommend removing the top aprismatic enamel common on primary teeth by removal with a carbide bur or sandblasting followed by etching for 30-60 seconds with phosphoric acid 37%.
  - c. Succedaneous (adult) teeth may have aprismatic enamel or hypocalcified enamel which would also benefit from additional surface preparation and extended etch time.

### **Rinsing tooth surfaces**

1. At the end of the etching time the etching gel is suctioned off and then rinsed off with forceful water spray. The goals are to remove the etchant **AND** **precipitated products of the etching.**

2. Focus on rinsing off the etchant while effectively suctioning the liquid to avoid pooling and recontamination of the etched surfaces.
3. Once the etchant is removed, switch to forceful spray of a oil-free water for 15 seconds to improve surface cleaning removing **etchant** debris..
4. Remember rinsing not only removes the etchant, it is also critical to continue rinsing to remove the calcium salts and open up the depressions in the enamel to accept the bonding agent.
5. At the end of rinsing and high speed suction the etchant will have been completely eliminated along with excess fluids, while the teeth will remain wet.

### **Drying teeth**

1. At the end of the rinse cycle, before air drying the teeth, inspect the oral cavity for residual etchant in contact with the tissue or remaining on the teeth. Removing the etchant at this time can eliminate prolonged contact of acid with soft tissue and subsequent chemical irritation of the tissue.
2. Reevaluate the oral cavity and eliminate any pooled saliva or water before starting to dry the teeth. The goal is to avoid blowing saliva or debris on to the etched surface reducing bond strength.
3. If cotton rolls are in place and saturated either dry with the high speed suction or carefully replace the cotton rolls avoiding contact with the tooth surfaces when removing the cotton rolls.
4. The drying step is critical to the strength of the bond as effective drying allows for deeper penetration of the resin increasing the length of the resin tags that mechanically lock the bonding agent to the enamel.
5. Once the teeth are well isolated and no saliva or water is present which might blow onto the clean tooth surface, it is time to dry the surface.
  - a. The air water syringe is a common instrument for drying the teeth with certain provisions.
  - b. Make sure the air water syringe stops the flow of water when the air is pressed separately. Observe for the presence of water vapor in the syringe and rewetting of the tooth surface. There are rubber seals in the housing of the syringe which can be replaced if moisture continues to escape from the syringe tip.
  - c. Air dryers designed for orthodontics also can efficiently dry the teeth.
  - d. The high speed evacuation will pull moisture from the tooth surface, but may leave some residual moisture.
  - e. While drying the enamel, continue suctioning near the air water syringe tip periodically suctioning the oral cavity to avoid pooled saliva as before.
  - f. Properly conditioned enamel should exhibit a dull, matte, chalky, frosty-white appearance; if not, repeat etching procedure for an additional 15 to 20 seconds.
  - g. **Take the time** to adequately dry the teeth.
  - h.

### **Contamination of the tooth surface with saliva or crevicular fluids.**

1. Occasionally despite best efforts an etched and dried enamel surface is contaminated by saliva before the bonding agent is applied.
2. Once contaminated, do not proceed with the bonding process until the contamination has been corrected.
3. The saliva deposits debris in the irregularities of the enamel surface not allowing the resin to penetrate the enamel surface and create the strong mechanical bond.
4. You must etch the surface again. The depressions in the enamel with removal of the calcium salts occurred with the 30 second etching. A 10 second etch will clean the surface of the debris and once again allow full penetration of the resin.
5. **The best way to protect the etched surface is to apply and cure the bonding agent.**

### **Contamination of the resin bonded surface**

1. After the tooth surface is sealed with resin and ready for bonding of orthodontic brackets we are relying on a chemical bond between the resin on the tooth surface and the resin within the bonding composite placed on the bracket. If the surface of the light cured resin placed on the prepared enamel is contaminated with saliva the bond strength would be reduced by this smear layer of protein and associated debris.
2. The smear layer must be cleaned from the resin surface prior to placing a bracket loaded with composite.
3. Rinse to remove the smear layer, dry the surface, and reapply bonding agent thinning with air stream and light cure. At this point the resin is ready to accept the composite loaded bracket.

### **Are there different steps and materials for bonding to dental restorative materials?**

1. Preparing enamel for bonding has been described as a progression of steps to create a mechanical connection of the bonding resin to the enamel surface. A general description of bonding to different restorative materials is provided to give an understanding of concepts specific to bonding to gold, porcelain, and plastic or composite fillings. Review the instructions from the manufacturer and discuss the steps with the orthodontist. In most cases the common material is some form of primer that will prepare the surface to accept the normal bonding agents.
2. As with enamel the ultimate the goal is to create a strongly bonded surface layer of bonding resin that will readily bond to the composite bonding paste on the back of the orthodontic bracket. Some of the following steps and materials may be needed to bond effectively. Become familiar with the different materials and memorize the order of these steps and when each is used. Create cards for the steps required for each material. The table provides general guidelines for each restorative material. Review instructions from the manufacturers to individualize the steps for the materials used in your orthodontic office.

Dental Material	Surface Cleaning or Roughening	Etching	Primers	Bonding Agents
Enamel	Pumice Surface	37% phosphoric acid	None	√
Porcelain	Occasional removal of glaze using micro etch or bur roughening	10% Hydrofluoric Acid	Porcelain primer	√
Gold	Micro etching or Bur roughening	None	4 Meta metal primer	√
Amalgam	Micro etching or Bur roughening	None	4 Meta metal primer	√
Plastic	Roughen surface with bur	Only enamel areas	Plastic Conditioner	√
Composite	Roughen surface with bur	Only enamel areas	Plastic Conditioner	√



Bonding Agents

### 1) Porcelain Bonding Preparation

1. The process to bond to a porcelain crown is dependent on a chemical and/or mechanical bond between the porcelain surface and the resin bonding agent.
2. Studies have shown that the highest bond strength combines both mechanical retention and chemical bonding of the porcelain and the bonding resin.
3. Porcelain as a special crystalline material requires a special acid and longer etching time to dissolve the surface creating irregularities for a **mechanical bond**. Hydrofluoric acid is used to alter the porcelain surface. This is a VERY corrosive material which will damage tissue and must be handled carefully with good isolation and control of acid placement.
4. To create the **chemical bond** between the porcelain and the bonding resin a Silane coupling agent or “porcelain primer”, is used after etching and allowed to chemically prepare the porcelain surface before air drying.
5. The typical preparation of porcelain involves cleaning of the porcelain surface, etching with hydrofluoric acid or phosphoric acid (less effective etching), porcelain primer application, and placement of the bonding resin, and finally bracket placement with the bonding paste.

6. The steps for a manufacturer's products should be reviewed and practiced prior to working with patients. This must include additional considerations for safety when using hydrofluoric acids including close attention to isolation techniques.



Porcelain Primer and Hydrofluoric Acid  
used for porcelain crowns.

## 2) Gold Crown Preparation

1. Gold crowns create some unique challenges as we are working with a material not of a crystalline structure that does not readily dissolve with acid.
2. Gold crowns are also impenetrable to light, a factor when considering curing of the composite coated brackets after placement on the gold crown.
3. Surface preparation for gold crowns includes roughening of the gold surface to create some mechanical retention with the bonding agent.
  - a. The surface is prepared with a carbide or diamond bur by the orthodontist.
  - b. An alternative with better mechanical retention involves micro etching the gold surface with a portable sandblasting unit.
4. Once the surface is prepared, increasing retention relies on a primer specific to metal or some of the universal materials designed to bond to varied materials
5. The metal primer is placed on the gold crown for a specified time by each manufacturer as well as the number of primer applications and then air dried.
6. The resin bonding agent is then applied over the metal primer creating the universal bonding surface that will create the chemical bond with the composite bonding paste placed on the back of the brackets.
7. Recognize that light transmitting from the light curing unit is limited by the metal bracket as well as the gold crown requiring additional curing time and curing at different angles and locations to compensate.
8. Some orthodontists may prefer a chemical curing bonding paste that does not require light curing when bonding to metal.



### 3) **Plastic Crown preparations**

1. The plastic crowns and composite restorations need cleansing and roughening of the surface before proceeding.
2. The orthodontist can roughen the surface with a diamond or carbide bur.
3. Temporary plastic crowns and composites require a special primer formulated for plastics.
4. Just as with the other primer, solutions for porcelain and gold, the primer remains on the surface and is air dried.
5. The bonding resin chemically bonds to the primed plastic surface. Once light cured, the surface will again bond chemically with the composite paste on the back of the brackets.

### 4) **Hyper-mineralized teeth**

1. Teeth near the salivary ducts may have an excessive layer of minerals on the surface of the enamel. The typical etching time with phosphoric acid will not dissolve these surface minerals quickly and penetrate the enamel sufficiently to create the long resin tags necessary for good mechanical retention. When encountered, it is necessary to increase the etching time to at least 60 seconds to dissolve the additional minerals on the surface as well as the calcium salts of the enamel.

### 5) **Primary teeth enamel bonding**

1. The primary enamel structure is not as organized as with adult teeth. It is recommended that the surface layer of aprismatic enamel be removed prior to etching with a carbide bur by the orthodontist.
2. The primary enamel may require additional etching time to provide adequate bond strength.

### 6) **Self Etching primers**

1. Self etching primers continue the progression of simplifying the bonding process by combining the etching and bonding materials in a single solution.
2. Self etching primers were designed to streamline the bonding step and reduce some of the technique sensitive steps prone to contamination and a reduction in bond strength.

3. Typically these materials are housed in a delivery system to protect the volatile materials from evaporating when exposed to air.
4. The materials are designed with compartmentalized materials requiring mixing to activate which provides convenience though a limited period in which to use the hybrid bonding agents.
5. The variation of the delivery systems and protocols requires individual evaluation and study, coordinating with the orthodontist before using these products.

### **Patient Protection**

#### **Acid etchant contact with soft tissue can cause injury.**

1. Continually monitor patients for location of etchant and remove immediately when in contact with soft tissue.
2. Thoroughly rinse soft tissue for up to 15 minutes when etchant is in contact with the soft tissue for an extended period of time can reduce the severity of etchant damage.
3. Avoid eye exposure to acid with proper control of material and safety glasses.
4. Be aware of eye wash station location and operation.
5. Review safety procedures with orthodontist.

### **Key words and concepts**

**Bond Failures** - bond failures directly relate to bond strengths. When any of the steps to a strong bond are missed or inadequately followed, the brackets will dislodge prematurely.

**Bond strength** - when we discuss bond strength, there is a minimum strength one would expect for a bonded bracket to remain on the tooth during normal function. On the other end of the range there is a maximum bond strength that when it fails will not tear away enamel. Modern composite materials and bonding agents are designed with bond strengths within this range.

**Bonding Agents** - liquids designed for application to a prepared dental surface in order to create a mechanical or chemical bond with this surface as well as possessing components which also will bond with brackets adhesives. The majority of these used today harden or cure with light curing units while some are composed of two parts which cure chemically.

**Bonding composites** - bonding pastes or bonding composites are “composed” or contain the resins or liquid portions found in bonding agents as well as particles that give composites strength. When composites and bond agents are in contact, light curing will chemically bond these to components together.



**Bonding Primers** - Consider the word primer as it is related to painting. Prior to painting a wall it is recommended to place a “primer paint” to improve the bond of the paint to the wall. Bonding primers improve the bond of the composite bonding agents and materials to the tooth in the same way.

**Etchant** - an acid designed to clean and etch the tooth surface. Etchants are different formulations of acid depending on the type of surface you are preparing.

**Filled resins** - the same as bonding composites filled resins are made of the liquid resins found in bonding agents as well as the “filler” which is the hard particles that give the bonding composites strength and a thicker more viscous composition. This allows the filled resins to effectively stick to the tooth surface when applying a bracket to the tooth.

**Pellicle** - a mixture of protein and plaque that coats the surface of teeth. The pellicle will instantly coat the tooth when the surface is contaminated by saliva, when contacted by the tongue or when in contact with the lip or cheek. The pellicle will inhibit a good bond to enamel if it contacts the freshly etched enamel surface of a tooth.

Students will complete study material for modules 4 preparing teeth for bonding and Module 5 bracket placement prior to proceeding with the laboratory section which will include instruction in the continuum of both procedures.

### **Laboratory Session 1 Hour**

During this session, students will practice the preparation of teeth for bonding with the application of materials on typodont teeth using appropriate etchants, primers according to type of enamel or restorative material being bonded.

#### **Typodont experience**

1. Practice protocol for bonding to enamel
2. Practice protocol for bonding to porcelain
3. Practice protocol for bonding to plastic
4. Practice protocol for bonding to gold/metal
5. Practice protocol for bonding to atypical enamel
6. Practice protocol for contaminated tooth

Students will work with a partner during the process of these procedures. The assisting student will observe each stage of the process for evaluation. The following is an approximate step-by-step description of the procedures that should be followed during the laboratory session.

1. Each student will set up his/her armamentaria for etchant and bonding placement.

2. Student will be provided with a typodont, a bench mount and four anterior and four posterior typodont teeth. In addition, the student will be provided with individualized packets that will include:
  - a. Description of packet
  - b. Etchant material in disposable syringe or bottle
  - c. Brushes/applicators for etchant application
  - d. Liquid wells or disposable sheets for dispensing materials
  - e. Bonding agent/primer in bottle or disposable syringe
3. Instructor will review procedures and present information on how to use worksheet for etchant and bonding placement.
4. Instructor will present criteria for ideal etchant, bonding resin placement. Instructor will provide ideal examples that will be passed around for viewing.
5. Student will place etchant on typodont tooth, partner observes, evaluates and records on worksheet. Student will also evaluate him/herself on the procedure. Instructor evaluates the etching process. The entire process will continue to be evaluated on the worksheet by the student, partner/assistant and instructor.
6. Partners switch places, the operator becomes the assistant and the assistant becomes the operator, both student partners have completed ~~at this point~~ three typodont teeth at this point.
7. Instructor will now present product evaluation form and how it is used to evaluate **final** etchant and bonding application.
8. Using the product evaluation form, the student operator and the student assistant and instructor grade the final etchant, bonding process for each other.
9. Discussion on product evaluation is conducted in small groups

### **Laboratory Session 5 Hours**

Laboratory practice on typodont teeth continues but now for specialized products used for bonding atypical enamel, porcelain, plastic, gold etc. and practice protocol for contaminated teeth.

### **Preclinical: Assistants working on each other in simulation**

During this session, student partners work on each other in simulation as described and demonstrated by instructor on day one. The following general procedures will occur:

Working with a partner, each student functions as an operator and applies etchant (faux) and bonding materials. Student will then function as an assistant, observe and evaluate placement with partner.

### **The following general procedures will occur for each patient:**

1. Operatory will be set up following the infection control guidelines.
2. Medical history will be completed by student/patient prior to seating.
3. Equipment and supplies will be checked by student.
4. Student/patient will be seated and prepared for treatment.
5. Student operator will review medical history and perform a patient assessment instructor will follow-up with same procedures.
6. Patient is given instructions/explanation of procedures

7. Student operator will perform the following according to the stated criteria
  - a. Perform coronal polish.
  - b. Isolate one quadrant and dry
  - c. Perform etchant (faux/simulated product) application procedures
  - d. Suction of “etchant” from tooth
  - e. Rinse and dry etched tooth/teeth.
  - f. Apply primer/bonding material(s)
  - g. Cure material (2 seconds only during simulation for easy removal)
  - h. Apply composite resin material
  - i. Cure composite resin material
  - j. Evaluate product using ideal criteria
  - k. Patient post-op instructions are given
  - l. Dismiss patient
  - m. Perform operatory clean-up according to infection control guidelines.

**During the procedure the following will take place:**

1. The student/operator will evaluate his/her own work according to stated criteria using the worksheet and product evaluation forms.
2. The student/assistant will assist, observe and evaluate operator’s performance according to criteria using the worksheet and product evaluation forms.
3. The instructor will evaluate both student’s work/performance using stated criteria using the worksheet and product evaluation forms. Discussion on results will be conducted.
4. The instructor will demonstrate and explain clinical examination protocol. When student performs last procedure on student partner it will be termed “mock exam” in preparation for the final exam on a clinical patient.

**Written Final Examination: 1 hour Modules 4 and 5**

**Clinical Instruction 4 hours**

During this session, the instructor will demonstrate the sequence of tooth preparation for bonding on active patients.

The following procedures will be demonstrated:

- a. Perform coronal polish.
- b. Isolate one quadrant and dry
- c. Perform etchant application procedures
- d. Suction of etchant from tooth
- e. Rinse and dry etched tooth/teeth.
- f. Apply primer/bonding material(s)
- g. Cure material
- h. Apply composite resin material
- i. Cure composite resin material

Student experience on active patients will include preparation for subsequent bracket bonding on four anterior and four posterior teeth a minimum of four times each, with one of each of the four times used for a practical exam.

The following general procedures will occur for each patient:

1. Operatory will be set up following the infection control guidelines.
2. Medical history will be completed by the patient prior to seating.
3. Equipment and supplies will be checked by student/operator.
4. The patient will be seated and prepared for treatment.
5. Student operator will review medical history and perform a patient assessment, instructor will follow-up with same procedures.
6. Patient is given instructions/explanation of procedures
7. Student operator will perform the following according to the stated criteria
  - a. Perform coronal polish.
  - b. Isolate one quadrant and dry.
  - c. Perform etchant application procedures.
  - d. Suction of etchant from tooth.
  - e. Rinse and dry etched tooth/teeth.
  - f. Apply primer/bonding material.(s)
  - g. Cure material.
  - h. Apply composite resin material.
  - i. Cure composite resin material.
  - j. Evaluate product using ideal criteria
  - k. Patient post-op instructions are given.
  - l. Dismiss patient.
  - m. Perform operatory clean-up according to infection control guidelines.

After the student operator completes the sequence of procedures, the student operator, the assistant and the instructor will evaluate the performance of the student operator using the worksheet and product evaluation

During this time period the following procedures will occur:

1. The student/operator will evaluate his/her own work according to stated criteria using the worksheet and product evaluation forms.
2. The student/assistant will assist, observe and evaluate operator's performance according to criteria using the worksheet and product evaluation forms.
3. The instructor will evaluate both students' work/performance using stated criteria using the worksheet and product evaluation forms. Discussion on results will be conducted.