Indirect Bonding Simplified
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**Introduction**

Indirect bonding has been around for a long time. There has been much published about the merits of indirect bonding including more accurate bracket placement, and as a result, better case finishing. In addition, there is no question that indirect bonding saves valuable doctor time at the chair (versus direct bonding). Time savings occur at bracket placement as well as throughout each patient’s treatment (placing bends, more frequent archwire changes, and similar adjustments to compensate for incorrect bracket positions). The productivity gains are enormous! As many of you know, these issues are near and dear to my heart. Why wouldn’t a doctor want to improve the quality of his/her work and spend less time treating every case?

As I lecture globally on practice management issues, the conversation often turns to clinical productivity. I always ask my audiences “who here routinely does indirect bonding.” I am amazed at how few have made the leap into indirect bonding. My sense is that those that don’t indirect bond have resisted simply because they know how technique sensitive the procedure is. It is for this reason that I have offered this article to de-mystify the process and to offer a reliable protocol that will allow any doctor the ability to use my method of indirect bonding.

**Observations & Experiences**

My journey to develop a foolproof indirect bonding system began about seven years ago. Recognizing the obvious benefits, I arranged for my entire office to spend a day visiting Dr. Anoop Sondhi at his office in Indianapolis. As all of you know, he is world renowned on the subject of indirect bonding. His system for chemical cure indirect bonding remains “the gold standard.” He and his orthodontic team graciously shared their secrets with us. We went back to our office and began.

Simultaneously, a number of my residents at the University of Illinois at Chicago (UIC) were experimenting with indirect bonding. Several of my residents visited offices and resident orthodontic programs where indirect bonding was being used routinely. The objective was to develop the “UIC System” for indirect bonding. The end of this process was a bonding system and a slide show prepared by one of my residents, Dr. Greg DeFelice. That new system involved 3M Unitek Transbond™ Plus Light Cure Band Adhesive, 3M Unitek Transbond™ Plus Self Etching Primer and Transbond™ Supreme LV Low Viscosity Light Cure Adhesive to prepare the teeth and bond the brackets. This represented a “breakthrough” for our office. It reduced the number of steps in the indirect bonding process while significantly decreasing bond failures and chair time.
Coincident with the above activities, our office was involved in numerous Six Sigma (quality enhancement) studies. The objectives of Six Sigma are:

1. Increase customer (patient) satisfaction
2. Decrease cycle time (faster new product utilization)
3. Improve excellence through zero defects

The applications of Six Sigma to the indirect bonding process are obvious. Our Six Sigma studies added the following refinements to the initial UIC protocol:

1. Orthoprint® Alginate made by Zhermack, produced good dimensional stability for impressions. Orthoprint Alginate led to the greatest accuracy for indirect bonding plaster models.
2. We found the best quality and most cost effective impressions occurred when we used Dental Corp of America (DCA) disposable trays and HOLD™ Tray Adhesive from Waterpik Inc. in conjunction with the Orthoprint Alginate.
3. Whip Mix’s Jade Stone™ High-Strength Die Stone material (crown and bridge plaster) gave the greatest detail for models and had the hardness desired for tray construction.
4. Re-applying a second application (double dipping) with 3M Unitek Transbond™ Plus Self Etching Primer reduced bond failure by 30% (more to follow).
5. Bond strength could be enhanced by either acid etching teeth before using the self etching primer or by using the dental version Adper™ Prompt™ L-Pop™ Self Etch Adhesive made by 3M ESPE.
6. Isolation and moisture control were critical to maximizing bond strength.
7. Interestingly, APC™ Adhesive Coated Appliance System (brackets pre-coated at the factory) had bond failure rates 1/3 less than those where we applied adhesive at the chair.
8. IPasma lights saved valuable doctor and assistant time while increasing bond strength.
9. The most important element needed for light cure bonding (versus chemical cure) was a light cured material designed to bond composite to enamel. At Illinois, we experimented with a plethora of materials. The breakthrough was a 3M ESPE dental restorative material called Filtek™ Supreme Plus Flowable Restorative as the agent to bond indirect bond “custom bases” to the enamel surface. 3M Unitek has now introduced an orthodontic formulation called Transbond™ Supreme LV Low Viscosity Light Cure Adhesive, the orthodontic version of this flowable adhesive. (Refer to Figure 1.) Today, Transbond Supreme LV Adhesive is highly regarded for light cured indirect bonding.

The Laboratory Protocol

A key to doctors utilizing indirect bonding lies in all the steps leading up to the final custom tray construction. Poorly fitting trays will lead to bond failure. Poorly positioned brackets in the trays will lead to repositioning appointments or excess time spent at the chair fabricating wires with compensating bends. Either of these outcomes extend treatment, create stress in the day-to-day activities at the chair, cost extra doctor and chair time (fixing something that “wasn’t right”), and general discontent. Is it any wonder that indirect bonding has NOT become standard operating procedure (SOP) in every orthodontic practice worldwide!

Anyone who has made the leap to indirect bonding knows there is a huge learning curve. It is MORE technique sensitive than any clinical procedure we perform. Yet, if the systems we developed are followed consistently and accurately, the end result can be a consistently better bracket and tube position (especially on hard to reach posterior teeth) with a very acceptable bond failure rate (ours is less than 3% from tray removal to a finished case). Better bracket positioning results in less archwire changes, fewer wire bends, and consistently better treatment results. Additional savings of time includes fewer visits, shorter visits, shorter treatment time, and ultimately less doctor and chair time to treat each case. Those not indirect bonding, what are you waiting for?

The Impression

Every orthodontist was taught in dental school that “the crown is only as good as the impression.” Implied is that if your impression is anything other than perfect that all the steps that follow will be compromised and the final product will be inferior or unacceptable. Thus, the first step in the highly technique sensitive process of tray fabrication is taking an acceptable impression.

This office has engaged in numerous Six Sigma studies over the last decade. We experimented with all of the commercially available alginates and impression trays. For alginate, we were looking for dimensional stability as well as ease of mixing and cost effectiveness. While Kromopan™ Alginate by Dental Corp of America
is known as a superior alginate for crown and bridge impressions, after eight months of testing, we found we preferred Orthoprint by Zhermack International. Orthoprint was among the least expensive alginites tested, the dimensional stability was the best, and it had the highest ranking of all alginates in the rating “the first impression is the last.”

Similarly, we studied various impression trays. We needed to change our focus from producing impressions with good soft tissue anatomy and think more about dental anatomy (as in crown and bridge impressions). We were looking for the disposable tray that best afforded the dental detail we needed. We found DCA trays the best, augmented by the spray HOLD Tray Adhesive from Waterpk Inc.

Finally I should tell you that we mix alginate in an unconventional way. We pre-measure the alginate into “baggies.” When an impression is needed we pull out a baggie, add the appropriate amount of water, twist the baggie top to close it (capture a little air) and vigorously mix the alginate against the palm of our hand. Now simply tear a corner of the baggie and squeeze out the alginate into the tray (much like a pastry chef decorates a cake). The net result is a better, smoother, more consistent mix with no clean up which saves valuable cleanup time. This approach is also much more OSHA compliant than mixing bowls. Try it!

The Pour Up

Obviously an important concept here is no bubbles in the plaster model. To accomplish this, vacuum mix the plaster. It is also important to pour the model within minutes of taking the impression. Additionally, we found (another Six Sigma study) that Whip Mix’s Jade Stone High-Strength Die Stone, crown and bridge die material, was the dental stone that had the best mix of hardness and workability to produce the best indirect bonding plaster model.

A final thought. Resist the temptation to use cheaper products or in some other way cut corners on impressions and pour ups. If you begin tray construction with a great study model, the hardest part of tray construction is done.

Placing the Brackets (on the Model)

Once the plaster models are “set,” observe for bubbles. Air trapped during impressions will create “positive” bubbles (bumps) on the model. Air trapped during the pour up will produce voids on the model. Voids in critical areas (the teeth) necessitate new impressions as re-pouring the same impression invariably leads to loss of detail as well as distortion. Both outcomes lead to trays that will not fit. Positive bubbles should be left alone (resist the temptation to “pick them”). They are of no impact to the final tray construction unless they exist where brackets or tubes are to be placed.

We next dry the model in a simple toaster oven at 300° for 20 minutes. (It is also acceptable to air dry overnight if you prefer.) The next step is applying separating medium to facilitate tray removal after construction is completed. We recommend Foilcote™ Liquid Foil Substitute from Whip Mix diluted 1:4 with water. After applying Foilcote, air dry. The model is now ready for bracket placement. The technician pre-positions each bracket or tube according to your prescription. The doctor does a final check.

In our office (we have well trained lab people), the final check by the doctor amounts to at most two minutes per case for both arches.

I strongly recommend the use of brackets from the APC™ Adhesive Coated Appliance System. The dispensing that is done at the factory of “just the right amount” of APC Adhesive is a valuable time saving benefit for placing brackets direct or indirect. There may be fewer bond failures, because the APC Adhesive is injected into the mesh of the bracket pad at the factory, and it might just better engage the undercuts of the mesh much more completely than could be accomplished at chairside, possibly leading to stronger bonds.

Further, the small amount of “flash” resulting from APC Adhesive System brackets versus self applied reduces time in flash removal while minimizing the movement of the bracket that inevitably occurs while removing excessive flash. These things combined reduce bond failure, an expensive “chairside crisis creating” problem we all face.

To properly position brackets and tubes, it is imperative to use some sort of “guide” for bracket positioning. This requires the laboratory technician to first scribe on each tooth a line representing the long axis of each tooth (use a panorex for assistance). Next the technician scribes a line that would represent the center of the slot on each tooth. The objective of this exercise is to “line up the slots” so that a straight wire (i.e., no bends needed) can be placed in case finishing. This is one of the critical steps that is difficult to visualize at the chair when you are direct bonding. Mounting brackets and tubes on a plaster model affords the technician (and later the doctor) to more accurately get each bracket or tube EXACTLY RIGHT. Further, placing brackets off center for rotation and similar needs is much easier to do in a relaxed environment than “at the moment” at the chair, stressed out by limited material working time, moisture, and a tight patient schedule.

3M Unitek offers the MBT™ Versatile+ Appliance System and Sondhi™ Signature Treatment System bracket positioning guide to position brackets and tubes relative to incisal edges and cusp tips. (Refer to Figure 2.) I prefer to position brackets relative to marginal ridges in posterior teeth, a concept proposed by Dr. John Kalange of Boise, Idaho. It makes more sense in leveling to get the marginal ridges all in a straight line. Too many times cusp tip or incisal edge wear prior to treatment or irregular anatomy (visualize pointed teeth, fractured teeth, or misshapen teeth) will get in the way of truly
accomplishing maximum intercuspation of a case at the conclusion of treatment. In these cases we build into our laboratory setup anticipated needs for reshaping of teeth from the start, minimizing our work in coming months.

Another consideration you must make is what to do when confronted with a model having one or more teeth with short clinical crowns. This can occur in cases of partially erupted teeth, poor oral hygiene, or simply short teeth. If this is a frequent finding on a model, this is not a good case for indirect bonding. Direct bond these cases. If this is a finding on only one or two teeth, your choices are:

- To omit the tooth or teeth from the tray setup
- To scrape plaster to “lengthen the crown” of the involved tooth. (This would be akin to placing the bracket and sliding it subgingival in direct bonding.) If you elect to “lengthen the crown” by scraping plaster, I highly recommend that only the doctor do this. It will be imperative to recreate the contours of the tooth or there will be a weak bond. Only the doctor has the knowledge of dental anatomy to “visualize” this as he/she scrapes plaster.

One final thought: The models must be kept in a light tight storage container from the moment brackets are initially placed on the plaster model by the technician until the construction of the custom trays (see section below). Remember, the adhesive will begin to cure in ambient light. We find the Sondhi™ Rapid-Set Indirect Bonding Adhesive Kit available through 3M Unitek works wonderfully. (Refer to Figure 3.)

Making the Custom Tray

Tray construction begins with curing the APC Adhesive after the doctor has final checked bracket placement. We use the Triad® Visible Light Curing System, as recommended by Dr. Sondhi. (Refer to Figure 4.) After curing for five minutes in the Triad, our laboratory technician will collect several cases so as to set up an efficient “assembly line” for tray construction. The objective is to efficiently create as many custom trays in as few minutes of laboratory time as possible.

Once several cases are gathered, the technician will first block out the severe undercuts that ball hooks and similar attachments represent. This is done with polyvinylsiloxane (PVS) material. After experimenting with numerous vendors we have settled on Aquasil Ultra LV® by DENTSPLY, the same PVS recommended for the Invisalign® System. Figure 5 illustrates the placement of the PVS material. Place material UNDER the hook only.

After the undercuts are blocked out, it is time to prepare the first of two trays for each arch (one soft tray incorporating the brackets and tubes and one hard tray which fits over the soft tray). Both soft and hard trays are made in a Biostar® machine (suck down technique). The soft tray is made first from 1.5 mm Bioplast® (mouth guard) Tray Material. The plaster model with brackets attached is placed in the beads such that at least 3 mm of the model gingival to the brackets is exposed. The objective is to “trap” the brackets and tubes in the soft tray material with good apposition of the tray material gingival to the teeth. This ensures good apposition of the brackets at the time of bonding and helps seal the enamel surface from moisture.
After suck down, trim excess soft tray material with scissors (leave on the model) and spray with a silicone separating medium. We use Economist® from Slide Products Inc., as it has been FDA approved for use in the mouth.

Next immerse the model (with soft tray) in the beads to the level of the gingival edge of the brackets. (Refer to Figure 6.) Not seating far enough into the beads will cause the hard tray to adapt to undercuts, making it difficult to separate the two trays. Seating the model with beads too far occlusal will result in a hard tray without good adaptation. This tray will “float” on the bonding appointment, causing poor adaptation and inadequate pressure adapting the soft tray and brackets to the enamel. This increases bond failure and poor bracket position. The hard tray is also made in the Biostar with 0.75 Biocryl® tray material.

Remove the hard tray and trim with a straight handpiece. Next separate the soft tray from the model by soaking in water. After it is soaked, gently peel the soft tray from the model and remove the PVS material. If needed, microetch the pads (just a quick burst), blow away the silica with air, and clean with denatured alcohol. Our technician will now light cure each pad embedded in the custom tray to ensure the APC™ Adhesive is fully cured.

The final and critical step in tray construction is to cut a slit in the soft tray material on the lingual of the incisor and canine teeth. Figure 7 illustrates this. This is important to facilitate tray removal after bonding. It also makes unnecessary the sectioning of trays advocated by others (which I think adds to inaccuracy). The trays are now stored until the patient arrives.

The Chairside Protocol

This section of “Indirect Bonding Simplified” deals with the clinical system for bonding of the appliance. It is intended to walk you through the process of placing appliances using indirect bonding trays. There are many nuances to the system. Please read carefully.

Preparing the Teeth

Preparing the teeth for indirect bonding is pretty similar to the steps used to direct bond. In our office, we do the following:

- Microetch any crowns (stainless steel, gold, ceramic) first. Rinse thoroughly.
- Prophy all teeth and rinse thoroughly.
- Isolate.
- Apply Transbond™ Plus Self Etching Primer. (Refer to Figure 8.) KEY: Rub a full five seconds per tooth and re-wet the applicator after each tooth.
- If crowns exist, apply RelyX™ Ceramic Primer, a 3M ESPE product. (See Figure 9.) Importantly, rub aggressively with the applicator several times (for five seconds on each tooth).
- When the doctor arrives, ensure that the isolation is still effective. The doctor will re-apply Transbond Plus Self Etching Primer. Only “re-dip” the teeth (no need to rub for five seconds) and air dry. We have found this re-application reduces bond failure by 30%! If crowns are present, the doctor also re-applies the RelyX Ceramic Primer to them.

Moisture Control

No matter what method is used to prepare the teeth for direct bonding or indirect bonding, moisture will adversely affect bond strength. Moisture and bonding adhesives do not go well together. However, a tooth prepared with Transbond Plus Self Etching Primer is very hydrophilic. The stage is potentially set for reduced bond strength if moisture control is not meticulously maintained. If you follow the steps below, moisture control is easy.
Our system for isolation involves using standard cheek retractors augmented by Theta Dri-Angles® placed with the foil side always toward the teeth. Dri-angles are placed between the cheeks and the cheek retractors and between the teeth and the tongue. A “Pearl”: Scotch® Tape will tape the lingual pair together making it much easier to place, remove, and isolate the teeth. (Refer to Figure 10.) The combination of the saliva ejector and the dri-angles affords terrific moisture control, isolation, and visualization. Dri-angles can be purchased through your dental supplier; they come in two sizes. Except in the case of a small mouth, we only use the larger size.

![Figure 10: Theta Dri-Angles® taped together](image10)

The above isolation works beautifully when bonding 5x5 and in most 6x6 cases. When second molars are to be bonded (we bond all second molars), we have found it very useful to prescribe Sal-Tropine® Tablets. Sal-Tropine Tablets are an anti-sialagogue. We ask the patient to take two 0.4 mg tablets one hour before their appointment if they weigh 90 pounds or more. If they weigh less than 90 pounds, one tablet is prescribed. (Refer to Figure 11.)

Contraindications for taking Sal-Tropine tablets include:

- Glaucoma
- Those routinely taking medication for asthma or allergies
- Pregnancy

We buy tablets in quantity from the pharmacy and place the tablets in “penny envelopes” with the instructions printed on them.

![Figure 11: Sal-Tropine™ Tablets](image11)

Preparing the Trays

The indirect bonding trays should be made in advance of the bonding appointment. When the patient arrives, the “custom pads” on each bracket (made with APC™ Adhesive) must be primed to receive the adhesive that will bond them to the teeth. There are only two steps:

1. Apply Add&Bond Primer™ by Parkell, Inc., to the pads at the beginning of the appointment. Lightly air dry and place in a light tight box until ready to seat the custom trays. We use retainer cases for this purpose.

2. While the doctor is “wetting the teeth” (read below), the clinical assistant should place a “pin head” of Transbond™ Supreme LV Adhesive on each bracket or tube pad. (Refer to Figures 12 and 13.) It is important that immediately after placing this adhesive the tray be seated. Ambient light will begin to cure this resin. This is a critical, time sensitive step.

![Figure 12: Transbond™ Supreme LV Low Viscosity Light Cure Adhesive](image12)

![Figure 13: Only use a pin head – too much material will flow all over the tooth](image13)
Seating the Trays and Curing the Adhesive

When the doctor arrives at the chair, the assistant should have performed all the steps above except C-2. The doctor ensures proper isolation and air dries the teeth one arch at a time, beginning with the mandibular arch. The doctor immediately begins to re-apply the Transbond™ Plus Self Etching Primer “as fast as your hand can move.” (Remember, you are only re-wetting the enamel.) Immediately air dry vigorously. By the time you have finished re-wetting and dried the enamel, your assistant should be handing you the lower tray.

Seat the lower tray immediately. Have the patient bite on a cotton roll placed perpendicular to the dental arch in the bicuspid area. Ask the patient to bite firmly, and importantly, with constant pressure. (The lingual dri-angles allow the patient to do this while maintaining moisture control.)

Immediately light cure first at the midline, then at each central/lateral proximal, then on the right second molar, the right first molar, and then the left second molar and first molar. These seven “tacks” will begin the light curing and ensure that the trays remain in positive contact with the enamel.

Now repeat the process with the upper tray.

After the doctor has “tacked” both trays, he/she can walk away. With practice, the doctor time to indirect bond two arches 7x7 should take no longer than six or seven minutes.

The assistant will then light cure each interproximally for 10 seconds (five seconds if using a plasma light) through both the hard and soft tray.

It is important to ensure that the light guide tip is touching the tray to achieve an efficient cure. Next, the assistant removes the hard trays. Then he/she light cures the brackets and tubes through the soft trays (only) a second time – 10 seconds using an LED light or five seconds using a plasma light.

Soft Tray Removal

After the brackets have been light cured two times (once through both trays and once through only the soft tray), it is time to remove the soft tray. Slits previously cut in the soft tray on the lingual of 3x3 will facilitate tray removal. (Refer to Figure 7.) Importantly, these slits make it unnecessary to section the custom tray as is recommended by many. The soft tray can be literally stripped from the teeth in a rapid wrist snap in seconds as follows:

Begin peeling the trays from the lingual of the most posterior tooth to the buccal. As the tubes and later the brackets are “released” from the soft tray, keep working anteriorly, continue to peel from the lingual to the buccal or labial. With practice, one can remove an entire tray with a single motion in a few seconds.

Test each bracket with a scaler for bond strength. Also, floss each contact to ensure that the Transbond™ Supreme LV Adhesive has not flowed interproximally, bonding two teeth together.

Next, place your initial archwire. Our customary initial archwire is Unitek™ Nitinol SE .014. I find that it works wonderfully for unraveling.

Conclusion

This paper is my attempt to de-mystify the art and science of indirect bonding. The benefit to the doctor, his/her team, and the patients is undeniable. I have incorporated into this paper the outcomes of over six years of “experimenting” with the process and incorporating the findings of six different Six Sigma studies conducted on specific variables in the procedure. There is no question that indirect bonding is the most technique-sensitive procedure that we orthodontists perform. There is also no question that it is one of the most beneficial systems you can ever incorporate into your practice. I can assure you that if you follow what has been laid out that you too can enjoy bond failure rates of 3% or less (from tray removal to completion) while experiencing the joy of better treatment results easier and faster.

The above only highlights key steps in the clinical aspects of indirect bonding. I offer you the opportunity to request a complimentary copy of my teaching materials, including a comprehensive slide series, for indirect bonding from my website at www.orthobottomline.com. Please use these materials along with a copy of this article, “Indirect Bonding Simplified” to teach your laboratory and clinical staff my method of indirect bonding. Remember, the accuracy and consistency of their effort will be directly proportional to your training in the nuances of this system.

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I want to acknowledge Dr. Greg DeFelice and Dr. Anoop Sondhi for their help in getting our office “over the learning curve.” Indirect bonding is not only a system, it is an ongoing journey.