Orthodontic Bonding: A Direct Approach

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Abstract
Both direct and indirect bonding techniques have associated benefits and disadvantages. Mild improvements in bonding accuracy when using indirect bonding have been proposed to outweigh the additional procedures and costs. The advent of efficient pre-pasting and light-cured adhesives have improved direct bonding. It appears that to select one or the other technique is a more of practice management decision since excellent clinical results can be achieved with either. A comparison of the two techniques along with recommendations for simple improvements to the direct technique are presented.

Keywords
Direct bonding, indirect bonding, light cured adhesives.

The advent of bonding adhesives for orthodontics has been one of the most significant changes in the history of the specialty. At the outset, the accuracy of direct bonding of orthodontic brackets was restricted by the limited working time of the first generation of composite resin adhesives. In efforts to work within the constraints presented by the materials and to improve the accuracy of bracket placement, indirect bonding methods were developed. These procedures were also especially suited for lingual orthodontics due to significant variations in lingual dental morphology. With the subsequent introduction of light-cured adhesives and their virtually limitless working time, more precise and yet efficient direct bonding became feasible.

Sondhi has stated “proper bracket positioning is a critical part of contemporary orthodontic treatment, especially if some type of pre-adjusted prescription is utilized.” This is true whether brackets are directly or indirectly placed. Despite the use of some type of traditional dental surveyor, intraoral measuring device (e.g., Boone gauge, positioning jig), or computer-assisted “tooth-targeting system” for bracket placement and regardless if a technician, assistant, or the orthodontist places the brackets, it is the orthodontist-of-record that is ultimately responsible for that precise positioning.

Although there appears to be no difference in shear bond strength between brackets that are bonded directly or indirectly, there does seem to be a difference of opinion as to the level of accuracy that can be achieved with each. It would seem that brackets that are placed on dry stone models, using a precision “measuring gauge,” in the quiet and well-lit confines of a laboratory (rather than the more turbulent oral environment), should be more accurately positioned. In fact, those with more than just a passing academic interest in the indirect technique claim that their bracket placement is, indeed, significantly more precise. In contrast, Hodge and co-workers concluded that mean bracket placement errors were similar for both directly and indirectly bonded appliances. Similar findings were reported by Koo et al.; however, the indirect technique did demonstrate greater accuracy for bracket height.

If, however, we are simply splitting hairs (i.e., measuring fractions of millimeters in bracket position), then perhaps we should also take into equally serious consideration the much more substantial errors inherent to contemporary orthodontic treatment: errors in diagnosis/treatment planning, tolerances in manufacturing of brackets and wires, the fact that bracket prescriptions and bases are designed for the “average” tooth, and even the limited precision of arch wire bending during treatment. It is the accumulation of these errors that must be eliminated during treatment in order to achieve an ideal result at the conclusion. Therefore, any slight, but statistically significant improvement, derived from indirect bonding accuracy
may, at the end of the day, often be clinically insignificant. It is somewhat like purchasing a component stereo system to listen to music. You can purchase the most elaborate and sophisticated CD player or amplifier, but if you have substandard speakers or wiring, then the end result is a less than ideal listening experience; at least for the discerning audiophile. In other words, an attention to detail in all aspects of orthodontic care, not just bracket placement, appears a reasonable expectation.

Consequently, the choice between direct or indirect bonding appears to be more of a practice management decision than a treatment imperative. As such, we might then evaluate these two techniques in terms of a cost/benefit analysis without fear that patient care will somehow be egregiously affected by our selection.

Comparing the Clinical Procedures – At first glance, the clinical procedures for direct and indirect bonding are distinctly different; however, they appear to have many similarities when compared to one another in terms of the steps required for each:

**Direct bonding** – isolation, access, visualisation, adhesive application, individual bracket placement, flash-removal, and adhesive curing.

**Indirect bonding** – isolation, access, adhesive application, bracket tray placement, adhesive curing, and flash-removal.

If light-cured adhesives were pre-applied to the brackets prior to their placement on teeth, for either the indirect or direct technique, then both methods would benefit from one less clinical procedure. Otherwise, the principal clinical differences between these two techniques appear to be threefold: the mode of bracket placement, cost, and flash-removal.

Although a dental assistant can facilitate either technique, direct bonding requires more chair side minutes. This appears to be, at minimum, equitably balanced by time spent by a laboratory technician performing the specialized procedures of bracket placement on models and transfer tray fabrication for the indirect technique. Considering that both techniques also use the same devices for isolation of the dentition and the same adhesives, then the difference in cost is directly related to materials and equipment required for the laboratory procedures of the indirect technique.

**Light-cured Adhesives**

When using light-cured adhesives, the dental assistant can initially place all of the brackets on the teeth. In this manner, the orthodontist’s chair side time is reduced to simply the final positioning of those brackets. This does require a few more minutes than the indirect placement of an entire tray filled with brackets. In either case, the orthodontist is still responsible for the final positioning, whether that is accomplished on a stone model or directly on the teeth. Consequently, the orthodontist’s time commitment appears to be equivalent for either technique, but the practitioner can decide to spend those few minutes either in the laboratory or chair side with the patient.

A similar situation exists for the removal of the excess bonding adhesive that is expressed from under the bracket as it is seated onto the tooth. For the direct technique, this flash is removed just prior to the final positioning of each bracket and before light-cure activation. At this stage, the soft adhesive is easily removed with simply a dental scaler. In contrast, hardened flash is removed only after curing of the adhesive for the indirect technique. This may be a more tedious and time-consuming procedure, often requiring the use of rotary instruments.

If the added cost of materials, commitment to the intermediate laboratory procedures, and more difficult flash removal appear balanced with a slightly more accurate bracket placement, then the selection of indirect bonding is an easy one. If, however, the orthodontist realizes that some individualized wire-bending, bracket repositioning, and occasional use of a custom tooth positioner are on the horizon, no matter the bonding technique selected, then a direct approach may be ultimately simpler, easier to teach auxiliaries, and more economical to consider. Especially since patients do not all exhibit fully erupted dentitions (without crowding or rotations) and they may inadvertently “shear-off” a few brackets during treatment, some direct bonding may be an inescapable eventuality during typical orthodontic care anyway.

With that in mind, it is not the purpose of this communication to revisit the numerous references providing superb instruction in bracket bonding techniques, but rather, to provide some enhancements to the already established protocols for direct bonding.
Enhancements to Direct Bonding

Isolation, Access, and Visualization

Simply stated: if you cannot clearly see the tooth, you cannot accurately place a direct bond. Isolation of teeth to prevent contamination is also an issue for both direct and indirect bonding. In addition, ambient light

Figure 1: An operatory light filter (SafeVu, American Orthodontics, Inc., Sheboygan, WI), constructed from translucent “orange” acrylic, prevents premature polymerization of light-cured bonding adhesive and yet provides adequate light for accurate bracket placement. The filter is rotated into place, over the light source, only when needed.

Figure 3: Pre-pasting orthodontic brackets with light-cure adhesives, during assistant “downtime,” provides an economical method of improving the efficiency of direct bonding. After adhesive is applied, the bracket is placed onto a specially treated card to prevent loss of the adhesive when the bracket is subsequently removed (Slippery Bond Card, American Orthodontics, Inc., Sheboygan, WI). Cards are prepared with brackets specifically selected for a patient’s individual treatment plan. These cards are stored in a “light safe” that is transported to the operatory (Safe Box, American Orthodontics, Inc., Sheboygan, WI). A “work box,” constructed from “orange” translucent acrylic, prevents polymerization of light-cure adhesives by ambient light during the pre-pasting process (Work Box, American Orthodontics, Inc., Sheboygan, WI).

Figure 2: An adjustable cheek expander (WYRED, Glenroe Technologies, Inc., Bradenton, FL) produces both buccal and distal forces for improved access to posterior teeth during direct bonding. The terminal end of the spring steel wire can be used as a “finger rest” to apply more retraction to the cheek on the side where brackets are being applied.

Figure 4. Direct bonding tray includes a “slippery” card with pre-pasted brackets (Slippery Bond Card, American Orthodontics, Inc., Sheboygan, WI). An “orange” acrylic cover over the bracket card prevents premature polymerization of the adhesive (Chairside Cover, American Orthodontics, Inc., Sheboygan, WI).
Figure 5: Vertical orientation of brackets is the most problematic issue when direct bonding. A Boone gauge or some derivative is often used to measure the position of the edgewise slot from the incisal edge or cusp of the tooth.

Figure 6: Alternatives for vertical bracket orientation: 1) a vertical slot gauge or disposable measuring “stick” (clamped into a needle holder) is used to measure the incisal edge of the bracket to the incisal edge or cusp of the tooth. 2) a disposable measuring tape, also used to measure the bracket edge to the incisal edge or cusp. Both devices are placed directly on the facial surface of the tooth to reduce the rotational errors inherent with Boone-type gauges (Bracket gauges, Glenroe Technologies, Bradenton, FL; Butterfly Bracket System, American Orthodontics, Inc., Sheboygan, WI).

Figure 7: A filter “lollypop” to prevent premature polymerization of light-cure adhesive from ambient light is held over the brackets immediately after their initial placement. This device is removed when the orthodontist adjusts the final bracket positions.

Figure 8: Applying fluoride varnish (Duraflor, Pharmascience, Inc., Montreal, Canada) immediately after direct bond procedures helps to reduce enamel demineralization lesions. A thin coating of varnish is painted on the surfaces of the teeth, adjacent to the brackets, using a miniature sponge applicator.

Figure 9: A simple tray set-up for the re-application of a fluoride varnish at 3-4 months intervals during orthodontics to help reduce the potential for enamel “scars.” Only tooth brushing, isolation, and drying of the enamel are required prior to reapplication.

and operatory lights may prematurely reduce working time when light-cured adhesives are used. Therefore, some simple improvements in the clinical equipment involved may significantly enhance direct bonding.

Figure 1: An operatory light filter (SafeVu, American Orthodontics, Sheboygan, WI) and adjustable lip/cheek retractor (WYRED retractor, Glenroe Technologies, Bradenton, FL) are two simple...
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devices that were designed to improve this situation. The light filter is constructed of translucent “orange” acrylic and is placed directly in front of operatory lights to filter the light frequencies that would prematurely polymerize light-cured adhesives, while still providing adequate illumination for accurate bonding.

Although hydrophilic adhesives, glass ionomers, metal etch, and self-etch priming systems15 have gained popularity in recent years, they are not without their own inherent limitations. For example, Swartz15 has stated, “the preponderance of the studies investigating these materials with and without intentional water or saliva contamination suggests that they do not compensate for poor bonding procedure or saliva contamination.” In other words, placing a resin sealant or primer onto etched enamel prior to salivary pellicle formation is critical whether using a direct or indirect approach with any adhesive.16

A simple, yet adjustable, cheek expander produces not only lateral forces but also distal retraction of the lips to increase visibility and access to the posterior buccal segments. The force of expansion produced by the steel spring wire of the expander can be adjusted and the terminal wire portion is used as a finger rest to improve retraction on only the side of the patient where a bracket is being directly applied.

Pre-coating Brackets

The introduction of light-cured adhesives, featuring increased working times, immediately improved the accuracy of direct bonding placement. In fact, a dental assistant can place these adhesives on all of the brackets to be used for a particular patient, hours or days before their appointment. In this manner, the chair side time required for each patient is reduced. A “word box,” constructed using “orange” light filter plastic, prevents ambient light from prematurely curing the adhesive as it is applied on each bracket (Work Box, American Orthodontics, Inc., Sheboygan, WI) (Figure 3).17

An assistant selects only the specific brackets18,19 needed for a particular patient's treatment plan before applying the adhesive (e.g. premolar brackets are not pre-pasted if these teeth are to be extracted). The pre-pasted brackets are then placed on a specially treated card (Slippery Bond Card, American Orthodontics, Inc., Sheboygan, WI) to prevent adhesive dislodgement from the bracket base when the appliances are later removed from the card during direct bonding. The individual bracket cards are then stored in a “light safe” storage box along with cards for other patients to be bracketed that week (Storage Box, American Orthodontics, Inc., Sheboygan, WI) (Figure 4).

Accurate Bracketing

The vertical position of brackets is the most problematic aspect of direct bonding. In comparison, mesial-distal positioning and long-axis orientation have been reported to be just as accurate as found with indirect bonding. Consequently, some type of measuring device would seem to be a prerequisite to precise positioning of brackets with the direct technique.

The typical device used to measure vertical bracket position is the Boone gauge or some derivation thereof (Bracket Height Gauge, Glenroe Technologies, Bradenton, FL) (Figure 5). In general, these gauges are to be placed at a right angle to the labial surface of the tooth in the anterior region and parallel to the occlusal plane in the posterior. Unfortunately, undesired deviations in bracket position are possible if the device is not angulated properly. An alternative is to measure along the facial surface of the tooth from the incisal edge of the bracket, instead of the slot, to the incisal edge or cusp (r(Figure 6). In this manner, rotational errors are eliminated; however, a different bracket-positioning chart for your bracket prescription will need to be created.11

End Game: Flash Removal, Curing, and Fluoride Varnish

An “orange” acrylic filter can be held over the seated brackets to prevent premature polymerization from ambient light until the orthodontist performs final positioning (Mouth Shield, American Orthodontics, Inc., Sheboygan, WI) (Figure 7). Excess bonding material or “flash” is easily removed during final bracket positioning and prior to polymerization of the adhesive. A simple dental scaler hand instrument is placed in the bracket slot to orient it on the tooth surface and serves double duty to remove the expressed adhesive around the bond margins. This is undoubtedly less time-consuming and potential more comfortable for the patient than using a rotary instrument to remove hardened adhesive, as required by the indirect technique.

There are a number of options available for initiating the polymerization of light-cured adhesives (e.g.
halogen,20 LED, plasma lights, and lasers). Recently, argon lasers have been shown to significantly decrease enamel demineralization.21,22 Therefore, if the cost of these lasers becomes affordable, they may become more prevalent in orthodontic practice. Until that time, the routine application of a fluoride dental varnish (Durafillor, Pharmascience, Montreal, Canada) immediately after the placement of brackets, with re-application every 3-4 months during treatment, has been demonstrated to provide some reduction of enamel demineralization.23,24

A thin coating of varnish is painted on the exposed enamel of the facial surface, immediately after light curing of brackets and while the teeth are still dry (Figure 8).25 The added minute or so of time and low cost of this material is worthwhile, especially if it might prevent or at least diminish the prevalent and unaesthetic dilemma of enamel scars. Periodic re-application of varnish only requires simple tooth brushing and isolation. For that reason, it can be easily incorporated into routine orthodontic adjustment visits (Figure 9).

**Direct or Indirect: Is That Really the Question?**

Both direct and indirect methods of orthodontic bracket placement can produce accurate and favorable results. Some difference in procedures and costs are the major determinants in selecting one method over the other. Objective self-assessment of finished cases (e.g., ABO Discrepancy Index,26 PAR Index27) and/or peer-reviewed evaluations (e.g., American Board of Orthodontics or Angle Society examination, study clubs, case presentations), combined with an attention to detail in all aspects of orthodontic care, seem to be just as important electives. Their utilization may help to avoid stagnation in practice and repetition of the same errors, while simultaneously optimizing improvements in finished results for orthodontic patients. In other words, the only way to assess the accuracy of your finished cases, including your chosen bonding technique, is to measure the outcomes and then fine-tune your treatment procedures as a result.

*Orange box system, SafeVu light filter, and Butterfly System are available from American Orthodontics, Inc., 1714 Cambridge Ave., Sheboygan, WI 53082.

**WYRED cheek retractor and bracket position gauges are available from Glenroe Technologies, 1912 44th Ave. East, Bradenton, FL 34203.

***Durafillor fluoride varnish from Pharmascience Laboratories, Inc., 10 Orchard Place, Tenafly, NJ 07670 is available from most dental suppliers.

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**References**


