BACK to the FUTURE

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A direct approach to orthodontic bonding

The advent of bonding adhesives for orthodontics has been one of the most significant changes in the history of the specialty. Both direct and indirect bonding techniques have become more refined in clinical practice in the ensuing years.

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.

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Sondhi[1] has stated "proper bracket positioning is a critical part of contemporary orthodontic treatment, especially if some type of preadjusted 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 (eg Boone gauge or positioning jig), or computer-assisted "tooth-targeting system" for bracket placement, and regardless whether a technician, assistant, or the orthodontist places the brackets, it is the orthodontist of record who 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,[2] 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.[3,4,5] In contrast, Hodge et al[6] concluded that mean bracket placement errors were similar for both directly and indirectly bonded appliances. Similar findings were reported by Koo et al;[7] however, the indirect technique did demonstrate greater accuracy for bracket height.

If, however, we are simply splitting hairs (ie, measuring fractions of millimeters in bracket position), then perhaps we should also take into equally serious consideration the much more substantial errors inherent in 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 archwire 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.[8] 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, the end result is a less-than-ideal listening experience, at least for the discerning audiophile. In other words, attention to detail in all aspects of orthodontic care, not just bracket placement, appears to be a reasonable expectation.

Consequently, the choice between direct and indirect bonding is 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

have many similarities when compared to one another in terms of the steps required for each.

Direct bonding: isolation, access, visualization, 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 preapplied 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 chairside 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 adhesives and the same devices for isolation of the dentition, 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 chairside time is reduced to 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 is equivalent for either technique, but the practitioner can decide to spend those few minutes either in the laboratory or chairside 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. Using the direct bonding 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 a dental scaler. In contrast, when using the indirect bonding technique, hardened flash is removed only after curing the adhesive. 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[9,10] are on the horizon, no matter the bonding technique selected, then, ultimately, a direct approach may be 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 article to revisit the numerous references providing superb instruction in bracket bonding techniques,[11,12,13] but rather to provide some enhancements to the already established protocols for 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 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.

An operatory light filter (Figure 1) and adjustable lip/cheek retractor (Figure 2) are two simple 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

Figure 1: An operatory light filter made of orange acrylic filters out light frequencies that would prematurely polymerize light-cured adhesives.

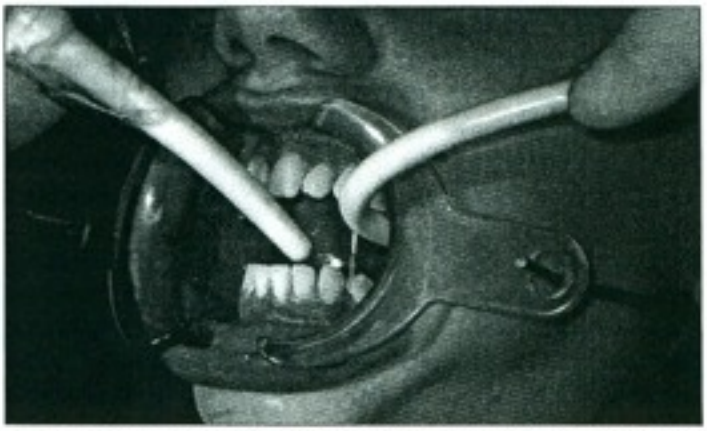

Figure 2: An adjustable cheek expander produces lateral forces and distal retraction of the lips to increase visibility and access to the posterior buccal segments.

Figure 3: Using a work box made of orange plastic allows assistants to place light-cured adhesive on brackets hours or days before an appointment.

Figure 4: After adhesive is applied to the brackets, they are placed on a specially treated card and stored in a light-safe storage box.

Figure 5: An orange acrylic filter held over the seated brackets prevents polymerization until the orthodontist performs final positioning.

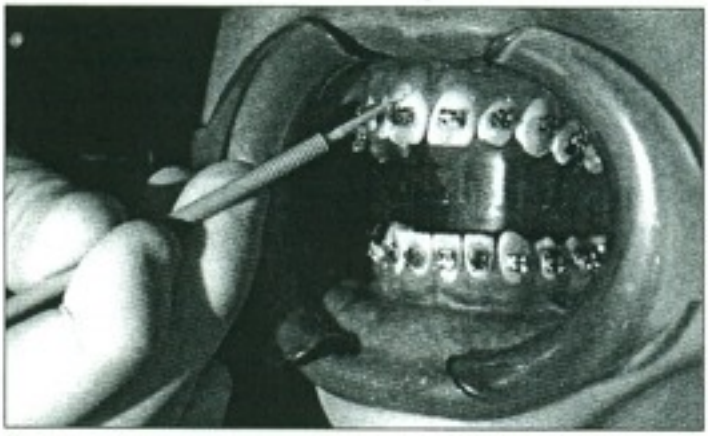

Figure 6: A thin coating of fluoride varnish is painted on the exposed enamel immediately after light curing of brackets and while the teeth are still dry.

adhesives, while still providing adequate illumination for accurate bonding.

Although hydrophilic adhesives, glass ionomers with polyacrylic acid etch, and self-etch primers[14] have gained popularity in recent years, they are not without their inherent limitations. For example, Swartz[15] 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 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 device can be adjusted and the terminal wire portion used as a finger rest to improve retraction on only the side of the patient where a bracket is being directly applied.

Precoating Brackets

The introduction of light-cured adhesives, with their increased working times, immediately improved the accuracy of direct bond 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 chairside time required for each patient is reduced. A work box constructed using orange light-filter plastic prevents ambient light from prematurely curing the adhesive as it is applied on each bracket (Figure 3).[17]

An assistant selects only the specific brackets needed for a particular patient's treatment plan before applying the adhesive (eg, premolar brackets are not prepasted if these teeth are to be extracted). The prepasted brackets are then placed on a specially treated card to prevent adhesive dislodgment 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 (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 with indirect bonding.[7] 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. 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. In this manner, rotational errors are minimized; however, a different bracket-positioning chart for your bracket prescription will need to be created.[11]

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 (Figure 5). Excess flash is easily removed during final bracket positioning and prior to polymerization of the adhesive. A simple dental scaler hand instrument serves double duty to remove the expressed adhesive around the bond margins. This is undoubtedly less time consuming and potentially 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 (eg, halogen,[18] LED, plasma lights, and lasers). Recently, argon lasers have been shown to significantly decrease enamel demineralization.[19,20] Therefore, if these lasers become affordable, they may become more prevalent in orthodontic practice. Until that time, the routine application of a fluoride dental varnish immediately after the placement of brackets, with reapplication every 3–4 months during treatment, has been demonstrated to provide some reduction of enamel demineralization.[21,22]

A thin coating of fluoride 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 6).[23] The added minute or so of time and the low cost of this material are worthwhile, especially if it might prevent or at least diminish the prevalent and unaesthetic dilemma of enamel scars. Periodic reapplication of varnish only requires simple tooth brushing and isolation. For that reason, it can be easily incorporated into routine orthodontic adjustment visits.

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 (eg, ABO Discrepancy Index, PAR Index, Andrews Score) and/or peer-reviewed evaluations (eg, 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. Using them 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. ⌘