SECTION B

Transitional Bonding

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RELEVANCE OF TRANSITIONAL BONDING TO ESTHETIC DENTISTRY

Transitional bonding allows practitioners to make major or minor changes in occlusion and esthetics with little or no reduction of tooth structure (Figure 15-2). With this approach it is possible to address cases with various esthetic problems, and, perhaps more important, health issues can often be treated. Examples include wear from bruxing; loss of occlusal tooth structure from erosion, decay, or fractures; and numerous teeth missing. Such situations may cause a decrease in vertical dimension leading to esthetic and functional problems. Restoring teeth that have worn down or are developmentally small so that the teeth are long enough or large enough to look more attractive without opening the bite could create a very deep overbite or other negative change. By increasing the vertical dimension one can often compensate for that.

Increasing the vertical dimension of occlusion (VDO) allows more space or clearance for restoring wear and lengthening the teeth. Most people will experience some loss of VDO with age. Many adults by the age of 50 could benefit from treatment that lengthens teeth for esthetic and/or functional improvements.

BRIEF HISTORY OF THE CLINICAL DEVELOPMENT AND EVOLUTION OF MATERIALS AND TECHNIQUES

The ability to adhere restorative materials to enamel and dentin is a critical development. Clinical dentists are now able to bond composite to tooth structure with a strength comparable to the bond of enamel to dentin. This adhesive bond is very long lasting and, under normal occlusal forces, will provide retention of a restoration for years.

Current composites are not routinely more fracture resistant than early versions, but by having particle sizes that allow them to be more polishable, the current materials are more esthetic. These materials' wear resistance is similar to that of enamel as well. The microhybrid and nanofill composites that have been developed in the last 20 to 25 years are critical for the success of transitional bonding. Handling properties that allow for placement, sculpting, curing on demand, contouring, and polishing allow these restorations to mimic natural tooth structure.

In the last few years the advantages of increasing VDO for patients who have lost some vertical dimension or who never had a fully developed VDO have become more accepted. This procedure can be predictably successful when the occlusion is handled properly.

RELATING FUNCTION AND ESTHETICS

Often the dentist is faced with conflicting demands between function and esthetics. The first step in preparing for any major change is an esthetic evaluation of the patient, using photography, study models, and a clinical examination. For a patient with obvious esthetic shortcomings, an "improved smile" should *not* be the goal—that is too easy. The goal should be to determine what changes would provide the "best smile possible" for a patient. A systematic approach to smile analysis, using smile design principles, promotes this goal. This would include principles such as the height-to-width ratio of the esthetic zone, width-to-length ratio of the upper central incisors, arch and tooth widths and proportions, and smile line, as well as numerous others.

Once the esthetic treatment plan has been determined, then the tooth size, shape, and position are evaluated in terms of whether they permit the ideal functional outcome. At this point the dentist determines whether the centrals have been lengthened sufficiently and whether that would create a deep bite that might compromise occlusal function. Determination of whether, and how, to adjust the occlusion to obtain ideal function would be the next important step. That might include increasing vertical dimension or, rarely, decreasing it. After occlusal principles have been used to confirm whether this esthetic change will work functionally, then the proposed treatment plan for the patient can be presented.

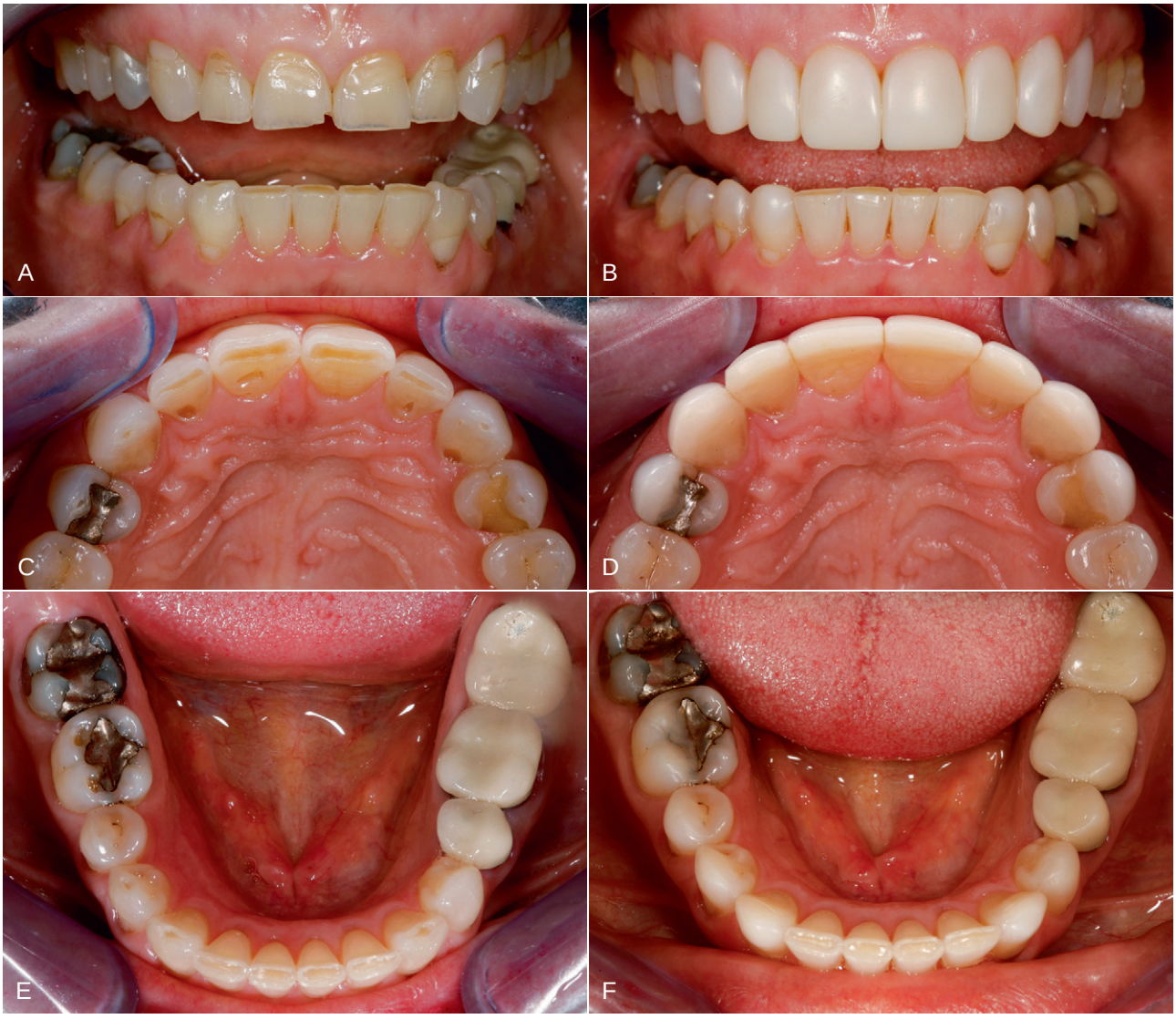

FIGURE 15-2 **Transitional bonding completed on the eight upper teeth, the cusps of the lower premolars, and the first molars to restore wear for esthetics and function. Vertical dimension of occlusion (VDO) was increased slightly. Pre-treatment (A, C, and E) and post-treatment (B, D, and F) photos.**

There will be some cases in which the esthetic and functional treatment plans cannot be rectified. For instance, increasing upper anterior tooth length results in greater overbite unless the VDO is increased. If the patient is an occlusal Class II, increasing VDO to compensate for this will result in an increased overjet if the mandible is in centric relation. So a compromise may be required to either the esthetic or the functional plan.

Each case is evaluated considering the dental and periodontal condition, but occlusion is a major factor. Generally, the goal is to end up with teeth of normal size and length, having a normal amount of overbite and overjet, with anterior guidance in protrusive and canine guidance in right and left lateral excursions. Ideally the guidance provides posterior disclusion. In successful cases these esthetic and functional goals will have been achieved.

CLINICAL CONSIDERATIONS

Indications

A common situation is severe wear caused by bruxism, in which the patient has a reduced vertical dimension. Such teeth can be restored to their original condition or better. In less common cases there may be a skeletal growth problem that produces a mismatch in the size of the maxilla and mandible, and a Class II or III occlusion. In a Class III patient whose maxilla is underdeveloped and tooth display is less than desired, upper teeth can be lengthened and bulked out facially for better esthetics including increased tooth display and lip support. By opening the vertical dimension in such cases, it may be possible to alter these cases enough that a Class I occlusion results, because when the mandible is in centric relation and VDO is increased, overjet also increases.

Extensive decay is a less common indication. Decay may be severe enough that loss of tooth structure has allowed some collapse of VDO as with tooth loss. Restoration of the teeth including increasing VDO creates better esthetics and function.

Another indication is a bulimic patient who has sufficient erosion of the upper lingual surfaces that anterior teeth have supererupted. Such patients may not have experienced an actual loss of vertical dimension if the posterior teeth are intact, but opening the bite can create enough occlusal clearance to restore these eroded surfaces without having to prepare them as for a traditional restoration—probably a crown—resulting in more loss of tooth structure.

The prior examples all include increasing VDO. However, the majority of restorative cases will not require that. A more common indication would be a patient who has worn the anterior teeth enough that anterior guidance is deficient, with resulting posterior interferences. Restoring anterior guidance can be accomplished without opening the bite. Building more guidance than the patient originally had may also be possible—in patients with developmentally small teeth, for example.

Overbite is increased if incisal length is added without increasing VDO. As long as this result is not excessive, there is no reason to consider this a deterrent.

Ideally, incisal and canine guidance should be built so that the posterior teeth disclude in all excursions. This posterior disclusion protects the posterior teeth. If the anterior teeth continue to wear, then rebuilding them as posterior interferences recur is a valid option, as opposed to equilibrating away enamel on posterior cusps.

Another indication would be a patient who has a slide from centric relation (CR) to maximum intercuspal position (MIP). Rather than equilibrate (removing enamel) to correct this, consider positioning the mandible at the first point of contact (typically second molars touching on one side) and augmenting other cusp tips to create new occlusal stops to stabilize this mandibular position, which now becomes the MIP. The slide can be eliminated without any enamel loss. Anterior centric stops can be built by adding to the lower incisal edges, but more commonly the author achieves this by adding to the lingual of the upper anterior teeth; often in combination with lengthening the upper anteriors.

This type of approach provides the patient with a more ideal occlusion (CR now coincides with MIP, and anterior guidance provides posterior disclusion) and results in a more esthetically pleasing smile (restoring worn upper anterior teeth for more tooth display); and conserves tooth structure (little or no prepping, nor an equilibration, is required). Numerous other advantages are achieved as well, but these alone make this option very desirable.

Contraindications

Periodontal disease and tooth mobility with anterior flaring could also be a reason for decreased VDO and a collapsed bite. One contraindication to lengthening teeth is periodontally involved, unstable, mobile teeth.

Another significant contraindication is the dentist who does not feel confident of his or her clinical skills related to technique. Transitional bonding is a somewhat technique-sensitive procedure, and without the training and experience to achieve predictable results, many dentists should hesitate to attempt it.

MATERIAL OPTIONS

Glass ionomers and resin ionomers are not appropriate material choices because of handling and mechanical properties. The material should be sculptable and fairly viscous, providing enough working time to adapt the material and then cure on demand. These materials do not hold up well in the occlusal situations with incisal edges and built up cusp tips. The compressive and shear forces during normal mastication—and certainly during bruxing—would likely cause fracture and wear on surfaces subjected to mastication. Esthetically these materials are lacking, as well.

Amalgam is not appropriate because of its un-esthetic properties and the difficulty in building up an incisal edge. Certain posterior situations might allow amalgam to be one choice—for instance, if old fillings or carious lesions also need restoration.

Ceramics may be appropriate but only for a definitive restoration—not a transitional restoration. Cost is a significant disadvantage as well. There are situations in which it is appropriate to restore some teeth in porcelain, whereas other areas of the mouth are treated with transitional bonding.

Composite is the ideal material for this procedure. It is the most versatile of all restorative materials and offers many advantages including the ability to adhere to tooth structure even in the most non-retentive situations. Handling and mechanical properties allow these restorations to be built intra-orally and to survive for an extended time.

Advantages of Composite

A significant advantage of using composite and the transitional bonding procedure is that it is possible to be extremely conservative in maintaining tooth structure. The great majority of cases require little or no preparation. If preparation is needed, it is more conservative than with any other option.

Another advantage is that these restorations are very easy to adjust as the dentist is refining occlusion or completing esthetic contouring. The composite can be reduced quite quickly or can be added to without much difficulty, if necessary.

The technique is a direct technique, so it does not require laboratory involvement other than for a diagnostic wax-up. A wax-up on mounted models is recommended so as to create a template (e.g., putty index) to aid in the intra-oral procedure. An excellent alternative to obtaining a lab wax-up is for the dentist to use composite on the mounted models and mock up the case. This provides valuable practice in handling composite, sculpting, and contouring—all skills that enhance the intra-oral result.

Composite can be very esthetic. Although the transitional bonding technique does not maximize the esthetic results—because there is no layering of materials for effects such as incisal translucency or shade blending—a major esthetic improvement can still be expected. The author estimates that 70% to 90% of the esthetic improvement can be accomplished with transitional bonding as compared to "ultimate esthetics" composite restorations or porcelain restorations.

Another advantage is the option to upgrade the treated teeth to definitive ceramic restorations at some point (either all at once or phased in a few teeth at a time), using any remaining composite—after preparation—as a core buildup. Another option is to improve the esthetics with composite by prepping away a portion of the transitional bonding and then layering composites of varying shades and/or translucencies for a more ideal, esthetic result.

In addition, the compatibility of composite with natural tooth structure in terms of wear is ideal. Having a material that wears slightly faster than enamel is desirable because it is preferable to have restorations wear rather than opposing natural teeth, as may occur with porcelain restorations.

Fracture resistance is another advantage. The fracture toughness values are so similar between composite and feldspathic porcelain that there is no significant statistical difference. In normal situations when the restorations are built properly, there should be no greater incidence of fracture than with porcelain restorations, similar to the incidence with natural teeth, as well.

Marginal integrity is an advantage, as well. With composite it is possible to develop margins that are extremely smooth and sealed—especially supragingival margins ending in a feathered finish over a bevel on enamel. On the other hand, consider the margin of a class II posterior composite with a deep proximal box: there is little or no enamel to bond to, more distance from the curing light, potential moisture control problems—all routine challenges for achieving sealed, smooth margins in class II composites. Most of the margins built in transitional bonding are supragingival, so the situation at the margin is very different; there is enamel, and a beveled margin means minimal bulk of composite, making polymerization shrinkage less critical—all factors that lead to margins that are very resistant to microleakage.

Finally, fees should be lower than for definitive restorations. If only anterior teeth are being treated, the savings may not be as dramatic as when many posterior teeth are included. The time to complete anterior teeth should be less than performing definitive restorations, but there is a much greater differential when building up buccal cusps of posterior teeth. So when more teeth are included in the treatment plan, generally the savings grow exponentially. This is a critical advantage for many patients.

Disadvantages of Composite

Longevity is still not as good as one might like. The restorations will not last as long, in most instances, as porcelain restorations. The dentist should appreciate that longevity is not every patient's highest priority. The advantages described earlier may be more valuable to many patients than longevity.

Technique sensitivity of any adhesive restoration is still a challenge. Moisture control in the wet environment of the mouth is often less successful than desirable—but this equally affects all materials to be bonded, not just composite.

Current Best Approach

Composite resin is the only material available that allows dentists to accomplish the transitional bonding procedure. The best approach is with composite.

OTHER CONSIDERATIONS

Since transitional bonding takes less time than definitive treatment, and no lab fees are incurred, the cost should be less than for almost any other option. It is easier for more patients to accept treatment when it can be offered at a more affordable cost. Financial considerations are the most important factor for many patients. Having an option between "traditional definitive treatment" and "no treatment" allows more patients to take advantage of what dentistry can do to improve their lives.

INNOVATIVE ELEMENTS

The ability to make a major change—whether it be a smile makeover for cosmetic purposes or a full-mouth rehabilitation for patients with severe breakdown—without prepping or with only very minor prepping is an important step forward. There is essentially no loss of tooth structure even though the esthetics and occlusion are dramatically improved.

Therefore, transitional bonding in most cases could be considered reversible treatment. When dealing with complex cases or very demanding patients, the option to "give the patient their old teeth back" may be very appealing.

The ability to bond composite to tooth structure is critical. Using adhesive techniques that provide predictably excellent bond strengths is easy today, with many adhesive systems and options available.

Current composite materials provide many benefits including good handling properties, fracture resistance comparable to most porcelains, wear compatibility with tooth structure, excellent esthetics, and polishability.

TREATMENT PLANNING

Options

Depending on the patient's needs and goals, the major portion of the treatment plan could be transitional bonding. If traditional, definitive treatment is planned—such as ceramic veneers or crowns—the provisional stage should accomplish many of the same benefits as transitional bonding. For more complex cases or demanding patients, transitional bonding allows more time

to work out esthetic or functional issues as needed, before definitive treatment.

Many treatment plans could include some definitive treatment combined with transitional bonding. An example would be 10 maxillary porcelain veneers and on the mandibular, transitional bonding to align worn incisal edges and open the VDO slightly to enhance the overall result, for a patient who cannot afford all the teeth to be restored in porcelain.

Another option is that additional treatment may be accomplished when specialists are involved, so interdisciplinary treatment can be completed before definitive restorations. This option can help ensure that costs are minimized. For example, a patient needs periodontal surgery to correct a dehiscence but also needs restorations because of significant wear that affects the occlusion and may be contributing to the periodontal problem. The transitional bonding can be done first to achieve most of the esthetic and occlusal goals, then the surgery can be completed and time allowed for healing. If the surgery is successful, definitive treatment can proceed, and if not, an extraction is followed by an implant or bridge.

Sequence

After an initial consultation, a comprehensive clinical examination of the patient is done. Once those records are gathered, diagnosis and treatment planning are accomplished. For cases with major changes, a diagnostic wax-up on mounted models is invaluable (Figure 15-3). Providing detailed instructions to the laboratory regarding tooth size, shape, and occlusal considerations helps ensure a successful outcome.

With the diagnostic wax-up in hand, a template is made to aid in the actual fabrication of the restorations in the mouth using a rigid polyvinyl siloxane material dispensed from an automix cartridge system or a hand-mixed putty. The template will be used to build the lingual and incisal surfaces of these restorations.

If upper and lower anterior teeth are to be restored, the lower anterior teeth should be treated first, followed by the upper anteriors. Generally the template is used to form the lingual and incisal surfaces of the anterior teeth being treated. Rarely should more than six teeth be augmented at once; attempting more will make control more difficult, increasing the chance of bonding teeth together. Then each individual tooth is directly built up on the facial and proximal surfaces freehand.

Once the anterior teeth have been completed, setting changes in vertical dimension and anterior guidance, then the posterior teeth are started. Normally the buccal cusp tips on *lower* teeth are functional cusps (accepting crossbite cases) and it is not necessary to build the lingual, non-functional cusps; lower buccal cusps create the new centric stops on the existing upper occlusal surfaces. On the other hand, the *upper* buccal cusps are non-functional, so they are built only for esthetic reasons, typically to blend the smile line of the longer anterior teeth toward the posterior; upper lingual cusps are functional, but as long as there is at least one centric stop on each tooth, long-term stability can be expected.

The lower posteriors should be completed before the upper teeth. When building lower buccal cusp tips—these functional cusps can be built up 1 mm or so to increase VDO—it should save time to avoid the template so that as each cusp tip is sculpted the patient can occlude into the new bite position before curing. This single uncured composite cusp conforms to the opposing tooth and is cured while the patient is holding that bite. After initial curing, the patient opens and the excess can be quickly contoured. If the amount of composite sculpted onto the cusp tip is fairly close to the correct amount, each cusp can be built in about 10 minutes so that all the posterior centric stops may be developed in an hour or two. If more than 1.5 to 2.0 mm is to be added to any cusp, it may be necessary to add composite to upper occlusal surfaces as well to create centric stops, so the lower buccal cusps do not become too long and pointed.

The upper posterior buccal cusps are completed last. These may be simple enough to sculpt freehand, or it may be helpful to cut the upper template in half (at the centrals) and use the right and left halves to form these longer cusps. Once the upper and lower posterior teeth are completed, checking excursions for posterior interferences is the next step. Adjusting the occlusion so that the centric stops are maintained and interferences are eliminated is accomplished by contouring only on the cusp slopes, not at the cusp tip with the centric stop.

TREATMENT CONSIDERATIONS

Preparation

There is virtually no preparation needed for most of these restorations. It is recommended that the teeth be pumiced with plain water mixed with fine pumice to ensure that the surface has no plaque, stain, or even pellicle layer to potentially inhibit adhesion. Next, any worn or chipped enamel surface should be lightly prepped, along with any exposed dentin. This accomplishes two goals: first, any sharp edges that have worn in should be rounded slightly; second, any sclerotic dentin should be lightly "freshened" for maximum adhesion.

On any anterior teeth that are visible in a smile, a very shallow bevel on the *facial* surface will provide a better blend from the composite to any visible tooth structure, which minimizes a "two-tone" effect. This bevel should be so minimal that dentin should never be exposed. In fact, the author recommends that less than half of the facial enamel thickness be reduced even where the preparation would be deepest—at the incisal edge—becoming shallower as the bevel extends to the margin. There should be no chamfer, with the bevel ending on the facial surface 2 to 3 mm from the incisal edge; a general guideline would be to make the bevel about as long as the amount of length to be added by the restoration (Figure 15-4).

Procedure

Because transitional bonding is so conservative, there is rarely a need for anesthetic. Unless a tooth is hypersensitive or there are subgingival extensions of the restorations, anesthesia should be unnecessary for the great majority of patients.

FIGURE 15-3 **A to C, Pre-operative condition: severely worn teeth resulting from bruxism. D to F, Diagnostic wax-up at the new, increased vertical dimension of occlusion (VDO). G to I, Teeth restored with transitional bonding. Occlusal views demonstrate the pre-operative condition of the worn teeth (J and K).**

FIGURE 15-3, cont'd **L and M, the diagnostic wax-up with the new occlusal stops at an increased VDO. Note that the upper anterior teeth have had wax added to the lingual and incisal surfaces, the lower anterior teeth have had wax added to the facial and incisal surfaces, and the posterior stops are developed by adding to the lower buccal cusps only. The post-operative photos (N and O) have the occlusal indicator paper marks present to highlight the new centric stops around the arch. These marks also show the protrusive, right and left lateral excursive contacts—this anterior guidance provides posterior disclusion.**

Pre-operative Procedure

A template is fabricated on a duplicate model of the wax-up using a rigid and accurate material. The template is trimmed to form the lingual and incisal surfaces while fully exposing the facial. Time is allowed for a polyvinyl siloxane material to de-gas before any composite is loaded. The template should extend beyond the teeth to be treated and onto surfaces without planned augmentation (including some of the lingual gingival tissue) to provide a place to apply pressure to fully seat the template. It is important not to press hard where composite is being added, as this could distort the template as it is seated.

FIGURE 15-4 **A and B,** The transitional bonding completed on the central and lateral incisors, demonstrating the shade blend from composite to enamel as viewed from the facial. Facial (C) and occlusal (D) views of an upper central incisor (before the minimal preparation) showing severe wear and dentin exposure. E and F, Minimal preparation with sharp corners slightly rounded, sclerotic dentin freshened, and a shallow facial bevel. Note the thickness of the facial enamel in the pre-operative view compared with the prepped view, which shows that less than half of the facial enamel thickness is reduced.

Shade Selection

The shade and opacity of composite closest to the body shade of the tooth to be restored are chosen. The same shade is not used for all the teeth if the shades vary. For example, the incisors may be A1, whereas more chromatic canines may be A2. If the final result will disguise the entire visible tooth, a different shade may be chosen, although typically the author does not whiten the overall smile very much during transitional bonding; that is reserved for the upgrade to definitive treatment.

Preparation Minimal preparation may be necessary, although many teeth should require no tooth reduction at all. If there are worn surfaces the preparation would involve *slightly* rounding any sharp corners and freshening exposed sclerotic dentin with a fine diamond bur. In addition, any facial surfaces that will not be completely covered with composite require a bevel to blend the shade *if* the margin will be visible with a full smile. Margins that are not visible need not have a bevel, because the bevel is used strictly for esthetic reasons, not for retention.

FIGURE 15-5 **Before (A) and after (B) views. Using a template—fabricated from a wax-up or mock-up—can save time when building composite restorations. These "before and after" views show the old composite that was replaced on the upper six anterior teeth. Part B was taken immediately post-operatively.**

Clean any unprepped surfaces with plain fine pumice and water in a prophy cup. It is important to remove any plaque, stain, or pellicle to achieve maximum adhesion.

Template Technique (Figure 15-5)

Loading the Template Generally the template is used to form the lingual and incisal surfaces of the anterior teeth being treated (Figure 15-6, *A* and *B*). Again, note that if the template is used for more than six teeth at a time, controlling the composite may be difficult.

Try in the template and evaluate how much composite should be loaded so as to develop the lingual and incisal surfaces (Figure 15-6, *C*). Having too much or too little material loaded will likely create time-consuming side effects such as gaps at the lingual margin or teeth bonded together. Using compules may save time loading the template with composite. Then the material should be smoothed and shaped so the proximals are separated (Figure 15-6, *D*). Place the loaded template in a dark place (a cabinet drawer may be a good option) until ready for seating.

Etch and Adhesive No shortcuts should be taken! The unprepped enamel is etched for approximately 60 seconds and the dentin for no longer than 15 seconds; prepped enamel can be etched for any length of time from 15 to 60 seconds. The directions for the adhesive of choice should be followed to ensure a good bond strength. Caution: Self-etching primers (sixth-generation agents) do not reliably bond to unprepped enamel.

Seat the Template The template is fully seated, and any excess is sculpted away, with special care taken to maintain a slight gap between teeth so as not to bond teeth together (Figure 15-6, *E*).

Light Cure and Remove the Template Curing from the facial is performed for a long enough time to set the composite on the lingual (Figure 15-6, *F*). The template is removed (Figure 15-6, *G*), and the lingual is checked for any areas of uncured composite; any pulled areas are sculpted and smoothed, then the material is cured.

Ensure Separation If any composite has bridged the proximals, it is recommended to separate the teeth using a diamond strip or saw before continuing.

Fully Form Each Tooth Add composite to the proximal and facial surfaces. Incremental buildup may be done for convenience but is not a requirement because the same composite is used to build the entire restoration. The restoration is light cured.

Contour Contouring is extremely important for achievement of the best esthetic result. Because transitional bonding restorations are a single shade, correct contour will offset somewhat the lack of polychromy. Without good contours however, these restorations can appear very unnatural and "Chiclet-like." Taking the time to learn accurate contours—especially of the upper anterior teeth—goes a long way toward having satisfied patients, regardless of the material and technique being used.

Using fluted carbide burs as well as contouring disks and strips is the most effective way to accurately develop contours, including adjusting occlusion. It is recommended that the finishing process be considered as two separate steps: contouring and polishing. Contouring should be completed before any polishing.

Final Cure Light curing in the presence of air creates an oxygen-inhibited layer on the surface of composite. If this layer is not removed, the surface of the restoration will be less resistant to wear and stain, and it will not polish as well. To ensure this is avoided, the restoration is covered with glycerin gel to block the air, then cured. Although curing for 5 to 10 seconds is generally sufficient to set an increment of composite so that it is rigid, 60 seconds is required for it to be maximally cured. So at some point after a restoration is fully formed but before it is polished, a final cure of 60 seconds with glycerin gel in place is advised. Commonly this is done after several teeth are built up, and the final cure is done on all these teeth at once by the dental assistant.

Polish Once the contours are correct, it is appropriate to polish. If any polishing occurs and more contouring is needed after that, the polishing will have been a wasted step. It may be helpful to accomplish the basic contours during the first treatment appointment but have the patient return another day to fine-tune the contours and polish. When one's eyes and attention are fresh, it can be easier to see what needs to be changed. This is even more

FIGURE 15-6 Template technique. **A,** A composite mock-up on a stone model is used to make the template from a rigid polyvinyl siloxane material. **B,** The template is trimmed so the entire facial surface is free and clear while the lingual surface and the full incisal edge of each tooth are formed by the template. **C,** The old composite is carefully removed so the underlying tooth structure is maintained. (There is a history of peg laterals in the patient's family.) After any minimal preparation is completed, the template is tried in to evaluate for how much composite should be placed into it. Once the template is loaded and the composite smoothed (**D**), it is stored in the dark to prevent premature curing (a drawer may be a good spot). After etch and adhesive, fully seat the template. **E,** Remove excess composite and blend so all junctions with the tooth structure are smooth. Ensure that the composite does not bond teeth together. **F,** Light cure sufficiently to set the composite. Curing to set the lingual may take a little longer. **G,** Remove the template and check that all areas of composite are cured. Smooth and light cure more if necessary. The lingual and incisal surfaces should be formed. Then each tooth is built up freehand to complete the case.

effective if photographs and study models are taken for review before the patient's return.

Polishing with finer disks and strips, or polishing cups embedded with polishing agents, should be a rapid process once the contours are correct. Within 1 to 2 minutes, a correctly contoured restoration should have the best polish the material can offer.

End Result Because much of transitional bonding is done freehand, it can be a fairly tedious process. To perform the procedure on eight to 12 teeth, assuming that at least six are anterior teeth, may require a full-day appointment in the office. Doing a full mouth could take 2 full days. Posterior teeth can generally be built much faster than anterior teeth, but overall it is still a relatively slow procedure. But considering that several restorations can be accomplished in a single appointment (because no "delivery" appointment is needed) it can still be time-efficient and certainly well worth the effort.

EVIDENCE-BASED PRINCIPLES

This procedure is a new application of composite and a dramatic change from the traditional uses commonly accepted for this material. Numerous articles validate the material properties of composites including a wear rate similar to that of enamel and fracture resistance similar to that of porcelain and tooth structure. Although the application of the material is innovative, the history of the material is long-standing.

CLINICAL CONSERVATION CONCEPTS

Conservation of tooth structure is a primary benefit of this technique. This is such a significant advantage that it makes this technique worth considering for many patients.

Another aspect that makes this beneficial is how composite fails. It is likely to be a "kinder, gentler" method of failure similar to enamel—development of wear facets or small chips—compared to a more dramatic failure with porcelain. Patients who traditionally would be treated with porcelain—usually considered the "strongest" esthetic restorative material—may be better served by having composite used. Consider a patient who is a bruxer but is unwilling to wear a nighttime appliance. (Of course, even patients who intend to be compliant often do not consistently wear their appliances.) Noncompliant patients will likely damage any restorations or opposing natural teeth much sooner than expected, therefore composite may be a more ideal choice for these patients since opposing teeth are unharmed and failure of the restorations are more similar to enamel failure. That includes noncompliant bruxers as well as patients who have habits such as biting their fingernails or crunching on ice.

The author believes transitional bonding could be a better option in the long run for noncompliant patients than more definitive treatment because of lower initial cost, ease of repair, and smaller risk to opposing natural teeth. Furthermore, the underlying tooth is essentially still intact (little or no preparation having been needed).

MAINTENANCE

Patients are instructed to treat these restorations in the same way as natural teeth. That means using them normally but not abusing them. Patients who are bruxing should wear a proper appliance every night. Harmful habits should be limited; it is important that patients be cautioned not to "use the teeth as tools" such as fingernail clippers, nut crackers, or scissors.

Normal use—chewing and incising—is acceptable with composite restorations, porcelain restorations, or natural teeth. Abuse, however, is not likely to be consistent with maximum longevity with any of these.

In the practice, the hygienist should use aluminum oxide polishing paste rather than typical prophy paste during prophylaxis, to maintain the finish on the restorations longer.

CONTROVERSIES

There are questions about whether major changes—esthetically and occlusally—should be accomplished with composite. Traditionally considered a "second rate material" compared with porcelain or gold, the idea that the same cases can be treated with composite is controversial to some. None of these cases will hold up as well over many years compared with traditional restorative options, yet it is important to consider that transitional bonding can conserve virtually all of the tooth structure and that it can save the patient potentially thousands of dollars in the initial treatment. For many patients, these benefits offset or outweigh the issue of longevity.

NEAR-FUTURE DEVELOPMENTS

Ideally the computer-aided design and manufacturing (CAD-CAM) technology available for porcelain will be available for uncured composite, so it would be possible to have the incisal edges or occlusal surfaces of the teeth custom made and presented to the dentist for placement. Uncured composite, if highly filled, should be rigid enough to hold its shape. Such restorations could be fabricated from impressions of teeth with the minimal preparation already completed, if needed (such minimal preparation would rarely necessitate temporaries).

Potentially this could be accomplished entirely with a digital system at some point in the future. With fairly rigid yet uncured restorations in hand, the teeth could be etched, adhesive placed, and each restoration positioned, with margins smoothed with a sculpting instrument, and then cured. In some cases the patient could bite onto the restoration before curing, for an easier adjusting of the occlusion. That would be an impressive time-saver and would make this technique much more likely to be used more frequently. In addition, esthetics and functional

properties might be improved to the point that this could be considered another definitive treatment option—greatly benefiting both patients and dentists.

SUGGESTED READINGS

Drummond JL: Degradation, fatigue, and failure of resin dental composite materials, *J Dent Res* 87(8):710-719, 2008.

El Mowafy OM, Watts DC: Fracture toughness of human dentin, *J Dent Res* 65(5):677-681, 1986.

Ergücü Z, Türkün LS, Aladag A: Color stability of nanocomposites polished with one-step systems, *Oper Dent* 33(4):413-420, 2008.

Fujishima A, Ferracane JL: Comparison of four modes of fracture toughness testing for dental composites, *Dent Mater* 12(1):38-43, 1996.

Ilie N, Hickel R: Investigations on mechanical behaviour of dental composites, *Clin Oral Investig* 13(4):427-438, 2009.

Jandt KD, Sigusch BW: Future perspectives of resin-based dental materials, *Dent Mater* 25(8):1001-1006, 2009.

Kim KH, Okuno O: Microfracture behaviour of composite resins containing irregular-shaped fillers, *J Oral Rehabil* 29(12):1153-1159, 2002.

Knobloch LA, Kerby RE, Seghi R, et al: Fracture toughness of packable and conventional composite materials, *J Prosthet Dent* 88(3):307-313, 2002.

Kovarik RE, Ergle JW, Fairhurst CW: Effects of specimen geometry on the measurement of fracture toughness, *Dent Mater* 7(3):166-169, 1991.

Krämer N, Reinelt C, Richter G, et al: Nanohybrid vs fine hybrid composite in class II cavities: clinical results and margin analysis after four years, *Dent Mater* 25(6):750-759, 2009.

Kvam K: Fracture toughness determination of ceramic and resin-based dental composites, *Biomaterials* 13(2):101-104, 1992.

LaBoda M, Sheridan J, Weinburg R: *The feasibility of open bite with an Essix retainer [thesis]*, Louisiana State University, 1995, Department of Orthodontics.

Lambrechts P, Braem M, Vuylsteke-Wauters M, Vanherle G: Quantitative in vivo wear of human enamel, *J Dent Res* 68(12):1752-1754, 1989.

Lundin SA, Koch G: Class I and II composite resin restorations: 4-year clinical follow up, *Swed Dent J* 13(6):217-227, 1989.

Magne P, Holz J: Stratification of composite restorations: systematic and durable replication of natural aesthetics, *Pract Periodontics Aesthet Dent* 8(1):61-68, 1996.

Magne P, So WS: Optical integration of incisoproximal restorations using the natural layering concept, *Quintessence Int* 39(8):633-643, 2008.

Mair LH: Ten-year clinical assessment of three posterior resin composites and two amalgams, *Quintessence Int* 29(8):483-490, 1998.

Marshall GW Jr, Balooch M, Gallagher RR, et al: Mechanical properties of the dentinoenamel junction: AFM studies of nanohardness, elastic modulus, and fracture, *J Biomed Mater Res* 54(1):87-95, 2001.

Morena R, Lockwood PE, Fairhurst CW: Fracture toughness of commercial dental porcelains, *Dent Mater* 2(2):58-62, 1986.

Pilliar RM, Vowles R, Williams DF: The effect of environmental aging on the fracture toughness of dental composites, *J Dent Res* 66(3):722-726, 1987.

Reality Online database (website): www.realityesthetics.com. Accessed November 16, 2010.

Spear F: Fundamental occlusal therapy considerations. In McNeill C, editor: *Science and practice of occlusion*, Chicago, 1997, Quintessence.

Taira M, Nomura Y, Wakasa K, et al: Studies on fracture toughness of dental ceramics, *J Oral Rehabil* 17(6):551-563, 1990.

Terry DA, Leinfelder KF, Geller W: *Aesthetic and restorative dentistry: material selection and technique*, Hanover Park, Ill, 2010, Quintessence.

Wassell RW, Walls AW, McCabe JF: Direct composite inlays versus conventional composite restorations: 5-year follow-up, *J Dent* 28(6):375-382, 2000.

Watanabe H, Khera SC, Vargas MA, Qian F: Fracture toughness comparison of six resin composites, *Dent Mater* 24(3):418-425, 2008.

Wilder AD Jr, May KN Jr, Bayne SC, et al: Seventeen-year clinical study of ultraviolet-cured posterior composite class I and II restorations, *J Esthet Dent* 11(3):135-142, 1999.

Willems G, Lambrechts P, Braem M, Vanherle G: Three-year follow-up of five posterior composites: in vivo wear, *J Dent* 21(2):74-78, 1993.

Willems G, Lambrechts P, Lesaffre E, et al: Three-year follow-up of five posterior composites: SEM study of differential wear, *J Dent* 21(2):79-86, 1993.

Wiskott HW, Belser UC: A rationale for a simplified occlusal design in restorative dentistry: historical review and clinical guidelines, *J Prosthet Dent* 73(2):169-183, 1995.