# Composite: The Ultimate Material for Minimally Invasive Dentistry

by Brian LeSage, DDS, FAGD, FAACD

## Educational Objectives

Upon completion of this course, participants should be able to achieve the following:

- Understand what are the three classification systems in composite materials and what are their indications.
- Learn clinical tips for Class I and Class II direct posterior restorations.
- Learn layering techniques to build in dentinal lobes, incisal edge effects and incisal halos.
- Learn simple polishing techniques to create the appropriate finish and luster.

## Introduction

Used in Class I, II and IV restorations in the posterior and anterior regions, composite resins represent an attractive restorative option for patients who desire minimally invasive treatment or cannot afford more costly indirect alternatives.[1,2] Among the most versatile materials, composites might be used in direct restorations, build-ups, cements, diagnostic mock-ups, gingival stabilization, provisionals and prototypes.[2] Although previous direct composite generations have demonstrated polymerization shrinkage and the potential for marginal leakage resulting in the development of secondary caries, their benefits today outweigh the risks, which can be avoided when proper materials and techniques are utilized.[3] A viable solution to the problems of amalgam, including cusp fractures, increased rates of secondary caries and possible toxicity due to mercury content, has increased the demand for composite resins in recent years.[2,4,5]

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## Composites

Conserving sound tooth structure and with the potential for tooth reinforcement, adhesively bonded composite restorations demonstrate aesthetically acceptable results. [6,7] The least invasive and predictable restoration of teeth to normal form and function, tooth-colored composites provide patients and dentists with a cost-effective and long-lasting solution for a variety of indications.[2,6] However, four parameters dictate an ideal composite material outcome:

- Mirror natural tooth structure in color and translucency.
- Strength to withstand function in high stress-bearing areas for the long term.
- Seamless or undetectable margins from restoration to tooth for the long term.
- Appropriate polish and luster that can be maintained throughout the life of the restoration.

### Hybrids

Compared by the author to rocks with pebbles loaded between them, hybrids or microhybrids are heavy-loaded materials that display an average 1µ glass particle sizes and .04µ silica in resin.[8,9] This class of materials demonstrates high strength and opacity similar to natural dentin and enamel. Less likely to chip, hybrids can provide strength in any of the functional areas and, through layering techniques, can mimic dentin and enamel morphology. A disadvantage, however, is that their polish is not long-lasting.[8,9]

### Microfills

Described as all pebbles and composed of an average 0.1 µ glass particles in resin, microfills display high polishability that lasts for the long term. [8,9] When compared to hybrids, microfills demonstrate a higher resistance to wear and a translucency similar to enamel. These materials also give dentists the ability to replace the color, translucency, polishability, wear resistance and surface texture of natural enamel. However, microfills lack the strength required for many of the functional areas and can be too translucent.[8,9]

### Nanofills (Nanohybrids)

A newer-class of composites, nanofilled materials display 20nm primary particle sizes, consisting of zirconia-silica nanoclusters and silica nanoparticles (0.01µ glass particles in resin).[10] Because this material contains even smaller particles, it has the potential to maintain greater strength and long-term polishability.[8-10] Therefore, according to the author's analogy of rocks and pebbles, nanofilled composites would additionally have grains of sand. In this analogy, when wear does occur, only pebbles and grains of sand "pluck out" leading to more favorable mechanical and optical properties.

Nanofilled composites also display opacity similar to natural enamel and dentin, with translucency similar to enamel. [10, 11] Demonstrating high strength, nanofilled composites are less likely to chip in high stress areas.[1] The only true disadvantage to nanofilled composites, however, is the lack of in-vivo long-term studies, since the material science is relatively new. [10-12]

When using the different types of composites, it is necessary to understand that both technique and material selection define the outcome. By using the proper composite, tints and opaquers, along with proper layering, customization and polishing, predictable restorative outcomes can be completed and maintained.[2,6,10]

## Aesthetics

Dentists must realize that there are many different characteristics of the teeth, which are key to understanding aesthetics, that need to be addressed during treatment planning. [13,14] When recreating tooth shape, the line angle, outline form and profile must be considered, along with tooth proportions, which involves the width-to-length ratio. To develop proper symmetry, the tooth shape must be developed first, followed by the embrasures and contact point. [13,14]

Another fundamental aspect of aesthetics, age and gender play important roles in the development of highly aesthetic and natural appearing restorations. [13-15] For example, age should be a major consideration when building the central incisors, and gender should define the lateral incisors. Other aesthetic considerations should include the smile line, cant, tooth size, central dominance, axial inclination, reverse "S and S" line angles and the natural curvature of the dentition. [13,14] The location and direction of the midline is also crucial to aesthetics and should be evaluated and developed prior to any preparation. [13-15]

Once the dentition is understood and a treatment plan developed, the facial characteristics of the patient and their skin tone must be evaluated. By doing so, harmony between the restorations and the patient's facial features can be created to develop the best in aesthetics. [13,14,16]

## Basic Principles for Adhesive Dentistry

A rubber dam should always be used to isolate the preparation and stop contamination from blood and saliva. [17-19] Rubber dams also provide the added benefit of preventing the patient from swallowing the potentially toxic mercury that is present in amalgam fillings.[17-19]

It is important to note that once removed, amalgam fillings should be disposed of properly. In 2007, the American Dental Association adopted "Best Management Practices for Amalgam Waste," which include the voluntary use of amalgam separators. Additionally, the Environmental Protection Agency has been reviewing options for regulating the dental industry regarding mercury discharge, as well as for requiring the installation of amalgam separators. [20] The author has an amalgam separator (DRNA ISO Certified BU10 Amalgam Separator, Dental Care

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Waste Management) in his office and encourages other practitioners to incorporate one in their practices also.

### Adhesive Systems

Once rubber dam isolation is achieved, the preparation should be etched, primed and then bonded to provide the most predictable results.[17-19] Of the adhesive systems available on the market today, total-etch, three-step systems are considered the "gold standard" and are the author's preference for indirect restorations.[21,22] These three-step systems come in two bottles and are indicated for use in all indirect and direct restorations. In comparison, a self-etching, two-step system, per the manufacturer, requires pre-etching on uncut enamel, essentially, from a technique standpoint, making a self-etching, two-step system a total-etch, three-step system.[21,22]

## Class-based Preparation and Placement

### Class I

To begin preparation of Class I indications, previous restorations and any remaining decay are first removed.[23,24] Bevels should not be used in these situations, and rounded line angles are required internally. An incremental filling technique must then be used when layering the new composite, being sure not to join the buccal-lingual walls.[23,24]

An example of this type of restorative procedure includes removing the decay and old restorations, then etching the dentin and enamel. The etchant is agitated while on the surface of the tooth and left for 15 to 30 seconds before being rinsed away. The dentin is then wet, followed by priming and bonding using a total-etch, one-bottle system. Multiple coats are placed and agitated before air-drying to remove the necessary contaminants (i.e., solvent).[25] To seal the dentin and enamel, the bonding agent is light cured.

To build the restoration, the cuspal inclines are formed using a microhybrid or nanohybrid composite in appropriate shades and tints where desired. Each individual layer is light cured (ramp cured) through the tooth. The cuspal inclines are adjusted as necessary.

### Class II

Like in Class I indications, the preparation for Class II restorations begins by removing amalgam or old composite and any remaining decay.[23,24] Once again, no bevel is used, and rounded line angles are required. The enamel periphery ideally would demonstrate 0.5mm to 1.0mm of enamel in height and width at the gingival floor. Layering is similar to Class I restorations, with incremental filling without joining the buccal-lingual walls.[23,24] For shading characteristics, 2+ shades of a microhybrid should be used, with incisal/translucent microhybrid or microfill layered over the restoration. Today's nanohybrid composites (Venus Diamond, Heraeus, South Bend, Illinois), however, can enable us to achieve such aesthetics with a single-layer composite material.

To form the interproximal contact of Class II restorations, several options are available, including pre-wedge before the rubber dam is placed, a sectional matrix with proper wedging, and utilization of special instrumentation.[23,26,27]

An example of a clinical case involves first cutting out the old amalgam filling. The rubber dam is placed, all previous material and decay is removed, and the matrix is placed. The preparation is then etched for 15 to 30 seconds. After the etchant is rinsed away and the surface partially dried, the total-etch, one-bottle adhesive is applied to the preparation with agitation in multiple coats and, after 30 seconds, thinned with air to blow off the necessary contaminant (i.e., solvent). The adhesive is light cured, after which incremental filling begins, followed by carving to form anatomy. After proper anatomy is achieved and occlusion is checked, the tooth is etched again and glazed. A surface glaze (BisCover LV, BISCO) is then placed on the restoration to lessen micro-leakage and post-operative sensitivity.

This incremental-oblique filling technique works well for Class II indications. Different from incremental-horizontal filling, the use of metallic bands with oblique increments lessens the polymerization shrinkage of composites and reduces the chance of microleakage.[26-28]

In a clinical example of this type of indication and technique, the old filling and decay are removed first (Fig. 1). A sectional matrix is then utilized, along with a wedge and oblique filling. Nanofilled composite material (Venus Diamond, Heraeus) is applied to the restoration (Fig. 2), with an enamel layer over it (Fig. 3).

*Fig. 1: Rubber dam isolation of broken-down teeth and restorations on teeth #30 and #31.*
*Fig. 2: Incremental filling was achieved by developing dentin cuspal inclines on teeth #30 and #31. Note the sectional matrix and wedge are used to assure proper interproximal contours.*
*Fig. 3: View of the completed, integrated restorations with appropriate marginal ridge contact and contours.*

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## Class IV

Class IV indications typically require diastema closure or full veneers and can involve no preparation to a full 1+mm of reduction.[23,24] To help with a seamless restoration, a starburst bevel of 2+mm should be utilized, except on the gingival margin if dentin is exposed. [24,27,28] Layering should be completed with at least two shades of a microhybrid material, overlaid with incisal/translucency, or microfill, to create the dentinal lobes, incisal translucency and the incisal halo.[27,28] However, today we can achieve this with a nanohybrid composite (Venus Diamond).

## Undetectable Margins

When margins are in the aesthetic zone, a starburst bevel should be used, followed by etching beyond the bevel.[23,27,28] The outer layer of composite should be rolled, while wearing clean gloves, to improve sculptability and prevent voids. The material should then be placed and super-cured, allowing five minutes or more for the material to settle.

The margin should then be addressed first, finishing it back between where the etch and the bevel end. Rubber wheels and polishers should not be used on the margins, since the rubber tends to become embedded in this area.[24,28,29]

## Case Study #1

A patient presented with chipping and slight rotation of the central incisors (Fig. 4). Discoloration and yellowing also were observed on the incisal edges, which needed to be corrected.

## Clinical Protocol

Although there were many issues with the teeth, no preparation was necessary, other than very light surface roughening to remove aprismatic enamel and allow for better bond retention. Before the teeth dehydrated, shade selections were made, along with a shade reproduction sample (Fig. 5). A sectional matrix was also placed to close the gingival black triangles and assist in composite placement.

Tooth #8 was prepared with a total-etch, one-bottle adhesive system (an etch-and-rinse one-step), primed, and bonded. A nanofilled artificial dentin material (Venus Diamond) was then layered on the tooth surface. Tinting material was also used to replicate maverick colors that appeared in the natural dentition. Once tooth #8 layering and preliminary outline form was complete (Fig. 6), tooth #9 underwent the same process.

Figure 7 shows the artificial dentin and tint materials having been placed on tooth #9, leaving room for the creation of incisal translucency using incisal opalescence composite in the incisal half. An A1 facial enamel was added and over-contoured slightly to allow for reductions where necessary (Fig. 8). The

*Fig. 4: Pre-operative view showing worn, chipped and rotated teeth #8, #9, and #10.*
*Fig. 5: Three convenient composite forms of varying shades were used in order to obtain ideal shade reproduction. Note the ever so slight bur marks removed aprismatic enamel and increased surface area for the bond.*

*Fig. 6: Layering and tinting created depth of color with tooth #8.*
*Fig. 7: View of the dentin lobe development and white maverick coloring on tooth #9.*

*Fig. 8: View of tooth #8 in its rough outline form and tooth #9 after layering various shades of composite and translucencies.*
*Fig. 9: View after completion of rough outline form for composite veneers on teeth #8 and #9. The first appointment achieved polish and initiation of secondary and tertiary anatomy.*

*Fig. 10: Completion of seamless composite veneers for teeth #8 and #9 and incisal edge repair of tooth #10.*

composite restorations were then polished 80 to 90 percent and a light layer of glaze was applied to protect the surfaces (Fig. 9). The patient was dismissed and returned within five days for evaluation and modification using all previously discussed smile design principles, as well as completion of texturing and polishing (Fig. 10).

## Case Study #2

A young woman was unhappy with the incisal edge of tooth #10 (Figs. 11 and 12). The tooth had been chipped during an accident and displayed some damage. To treatment plan this particular case, a photo-editing application (Photoshop, Adobe Systems Incorporated, San Jose, California) was used, along with images of the patient's dentition, to determine the correct profile required to restore tooth #10 (Figs. 13 and 14).

## Clinical Protocol

Using a typodont, a 45-degree Starburst bevel was demonstrated on the mesial half, and a 2mm to 3mm bevel was placed on the distal half (Fig. 15). The restoration was mocked-up on a stone model, and a matrix was created to assist in composite layering. The preparation was then etched beyond the bevel, primed and bonded. Using a nanofilled composite (Venus Diamond, Heraeus) and the matrix, the restoration was layered and then light cured. Images were taken and placed in Photoshop again to show the patient the change in the incisal edge of tooth #10. After the procedure, there was harmony and balance between the incisal edges of teeth #7 and #10 (Figs. 16 and 17), which is always our ultimate restorative goal.

## Conclusion

Cost-effective and long-lasting restorative options, direct composite restorations are among the most versatile treatments available today.[1,2] When used with the proper techniques and supporting materials, such as tints, opaquers and adhesives, direct composites offer predictable restorations for a variety of indications. As material science continues to advance, direct composites will undergo innovations and improvements beyond those experienced thus far.[30] For example, the introduction of nanohybrid composites (Venus Diamond) shows promise for enabling clinicians to achieve direct composite restorations that demonstrate greater strength and long-term polishability.

Additionally, nanohybrid composites promote the creation of minimally invasive aesthetic restorations, since they exhibit


*Fig. 11: Smile showing the fractured incisal edge of tooth #10.*
*Fig.12: Left retracted view of fracture tooth #10.*


*Fig. 13: Photoshop image with contrast to outline the pre-operative condition of the incisal edge of tooth #10.*
*Fig. 14: Photoshop image demonstrating the new incisal edge contour desired by the patient.*


*Fig. 15: Starburst bevel. Note that the bevels vary in depth, length and volume.*
*Fig. 16: View of the composite restoration recreating the depth of color and surface morphology of the natural dentition.*

*Fig. 17: Smile with harmony and balance created with bonding #10.*

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opacity similar to natural enamel and dentin, and translucency similar to enamel. By incorporating the use of nanofilled/nanohybrid composites to address patients' functional needs in a conservative manner, dentists also can fulfill their ethical professional obligations while simultaneously satisfying their aesthetic treatment objectives with low-cost and long-lasting treatments.[1,2] ■


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## Author's Bio

**Dr. Brian LeSage** graduated magna cum laude with the Omicron Kappa Upsilon Honor Dental Society award from the University of Maryland, Baltimore College of Dental Surgery in 1983. Over the past 27 years, he has actively integrated academic pursuits with a private practice, first in Washington D.C., and now in Beverly Hills, California, in aesthetic and reconstructive dentistry.

His national, as well as international symposia lectures, offer the most current inroads in cosmetic dentistry. Dr. LeSage is one of 300+ accredited cosmetic dentists in the worldwide American Academy of Cosmetic Dentistry. In 1996, he was appointed a consultant and examiner for the AACD accreditation process. He was awarded the status of fellow in the AACD, the 32nd.

Presently, Dr. LeSage is the Fellowship Chair and honored to be an ADA seminar series speaker. He also has fellowship status in the Academy of General Dentistry. In 2008 he reached a milestone in his dental career by being honored to join the American Academy of Esthetic Dentistry.

Dr. LeSage is the founder and director of the UCLA Aesthetic Continuum Levels I and II, which teaches practicing dentists the art and science of cosmetic dentistry. He is also the Director of the Beverly Hills Institute of Dental Esthetics. Comprehensive care dentistry is the foundation of his teaching philosophy.

*Disclosure: Dr. LeSage declares having received an honorarium from Heraeus for this lecture.*

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# Post-test

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1. The ideal composite restorative material has the following property(ies)?
   a. Mirror natural tooth structure in color and translucency
   b. Strength to withstand function in high stress-bearing areas for the long term
   c. Seamless and undetectable margin from restoration to tooth for the long term
   d. Achieve the appropriate polish and luster and maintain it for the long term
   e. All of the above

2. The composite class(es) that is/are best know for its (their) polishability, maintenance of polish, but can be too translucent and not indicated in a stress-bearing area is/are?
   a. Nanofiller
   b. MicroFill
   c. MicroHybrid
   d. A & C
   e. B & C

3. The composite class(es) that is/are relatively new, that has (have) the potential to exhibit the best of the two original classes, but has (have) no long-term in vivo studies yet?
   a. Nanofiller
   b. MicroFill
   c. MicroHybrid
   d. A & C
   e. B & C

4. When placing a posterior Class II composite, what technique or techniques can be employed to maximize the potential for a solid interproximal contact?
   a. Pre-wedge once rubber dam is placed
   b. Use of a sectional matrix and good wedge with or without 'bitene" ring
   c. Instrument specific for holding matrix tightly against the adjacent tooth
   d. Proper layering of the material
   e. All of the above

5. The first step in creating an undetectable margin is:
   a. Roll the outer layer with clean gloved hands
   b. Etch past the end of the bevel
   c. Place a proper bevel
   d. Do not use rubber on the margins
   e. None of the above

6. The following is/are fundamental parameters in creating natural appearing restorations:
   a. Aesthetics
   b. Age
   c. Gender
   d. All of the above
   e. None of the above

7. A starburst bevel varies in:
   a. Depth
   b. Length
   c. Volume
   d. A & B
   e. All of the above

8. The outer layer of composite should be rolled, while wearing clean gloves, to improve sculptability and prevent voids.
   a. True
   b. False

9. To help with a seamless restoration, a starburst bevel of 2+mm should be utilized, except on the gingival margin if dentin is exposed.
   a. True
   b. False

10. An ideal Cl-II composite posterior restoration should be done with the following parameter(s) in mind:
    a. Remove amalgam or old composite and any remaining decay
    b. No bevel
    c. Rounded line angles
    d. Enamel periphery ideally of 0.5 to 1.0mm in height and width at the gingival floor.
    e. All of the above

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