In my opinion (IMO) "greatest bondodontists of all time" (to great friend... until now. For some reason, and myself. I have long considered him a message boards at www.dentaltown.com, Graeme Milicich of Australia. I had the pleasure of meeting these men through the World Congress of Restorative Dentistry. Microdentistry and over the course of two years, they, along with Geoff Knight have completely changed the way I do restorative dentistry. White lines are microgaps between the restorative material and the cavity walls. They can be micro fractures in either the tooth substance or the composite. The presence of air in the micro gap creates a "white line" due to refractive index differential. White lines and micro gaps, then, are the same thing except one we see and one we don't because it is at the pulpal floor. Depending on where they are we can get post-op sensitivity, recurrent caries, or stained margins. These gaps are caused by one composite material problem—Composite SHRINKS when it is POLYMERIZED!

Shrinkage becomes more problematic with varying cavity contours and increasing composite volume. Let's deal with cavity contours first. Cavity Configuration Factor or "C-factor" is the effect of cavity configuration on restoration stresses. It is calculated by dividing the bonded walls of a prep by the unbonded ones.

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C = \frac{\text{Bonded walls}}{\text{Unbonded walls}}
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The lower the C-factor the better. For example, a smooth surface restoration is 1 bonded wall divided by 5 unbonded walls or a C-factor of .2. A Class IV is 2/4=.5.

A Class III is three walled or 3/3=1. Class II is 4 walled or 4/2=2 and a Class V or Class I is 5 walled or 5/1=5.

Increasing C-factor increases shrinkage stress loading on the tooth-resin interface leading to debonding. Once bond failure occurs post-op sensitivity and recurrent decay can occur.

Composite doesn't always shrink towards the light. In a two-walled cavity, shrinkage occurs towards the tooth due to flow from the large free surface. In an article by Feizler et al (Dent. Mat. 6:167-171, July 1990) it was concluded that stress reduction by flow was dependent on C-factor. Five-tenths=71% reduction in polymerization stress, 2=35% while 5=0 reduction. Therefore, we want to reduce C-factor as much as possible when placing our composites. Never join two opposing walls with an increment of composite because you get competing bonds. If the bond strength exceeds stress we get fracture or distortion of the tooth and if the stress exceeds bond strength we get gap formations or white lines.

Now let's discuss composite volume. The greater the cavity volume, the greater the shrinkage problem. How do we counteract this? One option would be to simply do an indirect restoration. The second option is to use a "co-cure" technique by replacing the dentin with an auto cure glass ionomer to control the shrinkage vectors and create a stable, low stress dentin bond, reduce composite volume to a manageable level. Glass ionomer shrinks the same as composite (about 3%) but there is only a 2mpa tensile load on the GIC bond as compared to up to 18mpa on a composite bond. GIC, incidentally, is one of the original self-etching bonding materials! GIC offers the best resistance to micro leakage, provides a rechargeable fluoride release to prevent recurrent decay. Control of leakage is far more significant than perceived bond strength. Resin bonding tests are performed on ideal surfaces. What is really under an old amalgam with sclerotic dentin and amalgam corrosion contaminated dentin? Are we really getting the bond strengths the manufacturers are telling us in the bottom of a proximal box? Sclerotic dentin, tubules at the wrong orientation (no tubule penetration, etc., high C-factor, no enamel on the bottom margin, etc.) No wonder we see so much recurrent decay in those areas under old composites.

Ten to fifteen percent of composite shrinkage occurs after initial polymerization. If the volume is high, this can be of significance even after careful incremental placement. This is another reason to reduce composite volume with GIC Bases.

The technique I use to restore posterior teeth is as follows:

After preparation, including a beveled cavosurface margin occlusally, unless I am using my Waterlase laser (which sterilizes as it cuts) I rinse the preparation with
This is followed by a five second application of GC Cavity Conditioner on the dentin and 10-second application of acid etches on the enamel at the margins. The tooth is thoroughly rinsed and left moist by turning the suction tip over the top of the preparation for 1-2 seconds. It is very important to leave the dentinal surface moist, as glass ionomer needs a moist surface for proper bonding. Then, Fuji IX Fast set or Fuji II LC—depending on the depth of the restoration—is mixed in an amalgamator and injected into the preparation replacing the dentin. The working time is three minutes GC Fuji Bond LC (powder and liquid) has been mixed and is applied over the surface of the glass ionomer with a Microbrush ball-type applicator teasing the GIC into place and then packing it down. I light-cure the GC Fuji Bond LC for 10 seconds with a high-speed curing light. A thin layer of flowable composite is placed over the surface and cured. This step can be skipped but I prefer it to give me a hardened surface to place my composite against in case the GIC has not set enough yet. Next, I place a coat of bonding agent over the entire restoration and margins and cure. Finally, I place the composite to replace the enamel and cure. The composite is placed in one of two ways. The first is to place and cure one cusp at a time, making certain that at no time does the uncured composite touch more than one or at the most two walls of the preparation to control the C-factor as previously discussed. The second way is not quite as esthetic but is much faster and often more practical. In this method, used by Graeme Milicich, DDS, the composite is placed in one bulk and then scored with a thin instrument down to the cured flowable as many times and directions as needed to insure only one wall is touching an increment and then cured. The score marks are then filled in with flowable or regular composite and cured. The final step after finishing and polishing is to etch, rinse, dry and seal with Optiguard, Fortify or other sealer of your choice.

There are variations to this technique using GC Fuji II LC instead of the GC Fuji IX GP and certainly, there are many other ways to get good restorations. From everything I’ve seen and tried over the years, this method seems to work the best. My results are excellent, quick, and predictable.

But don’t just take my word for it. Try it yourself. Or, better yet go and hear the results from the latest research for yourself at the World Congress of Microdentistry meeting in Newport Beach, CA; August 21-24, 2002. It was at this meeting last year in Australia that I learned all I am sharing with you now. For information call Annette Sigman at 800-475-5569 or email at Basigman@aol.com or visit the website at www.wcmicrodentistry.com.

Stewart Rosenberg, DDS, is a 1966 graduate of the University of Maryland. He is the founder and past president of the Academy of Laser Dentistry and currently President Elect of the World Congress of Microdentistry. Dr. Rosenberg maintains a busy private practice and is an attending doctor at Johns Hopkins Hospital treating drug-induced hyperplasias and mucositis in cancer patients. Dr. Rosenberg can be contacted by telephone at 301-776-3300 or write him at: 9101 Cherry Lane, Suite 202, Laurel, Maryland 20708.