# Introducing the CLARK CLASS I and II Restorations

**David Clark**, DDS

**Twenty-five years after their inception, posterior** composites remain unpredictable. In comparison to amalgam restorations, Class I and Class II composites show significantly higher failure rates, are more costly, take longer to place, have more postoperative symptoms, leak, stain, chip, and cause food impaction. (Figs. 1-3) My former operative dentistry instructor (a legend in the Pacific Northwest) continues to build his legacy today at the University of Washington School of Dentistry. He recently shared this opinion with me -- he "hates" posterior composites and hates to teach the technique. This sentiment shared at many dental schools across North America and therefore the posterior composite curriculum is limited.

In this article, I will briefly summarize the history and shortcomings of posterior composites. I will then examine new techniques, materials and instruments that allow **minimally traumatic tooth preparations** and address the most serious flaws of traditional posterior composite restorations.

## What's wrong with this picture?

Between 2005 and 2007, I lectured alongside Dr. Gordon Christensen and Mr. Derek Hein at the "CRA Dentistry Update". A good cross section of restorative dentists from around the USA and Canada attend these lectures. At each city (and also at my private lectures) I have asked attending dentists (now numbering more than 6,000 clinicians) this question: "*How many of you feel that posterior composites are holding up as well as amalgams?*" Only a few hands go up. Over 95 per cent have concluded that posterior composites are inferior to amalgams, yet most have stopped doing amalgam restorations and are placing posterior composites. Then I ask the attendees, *"So*

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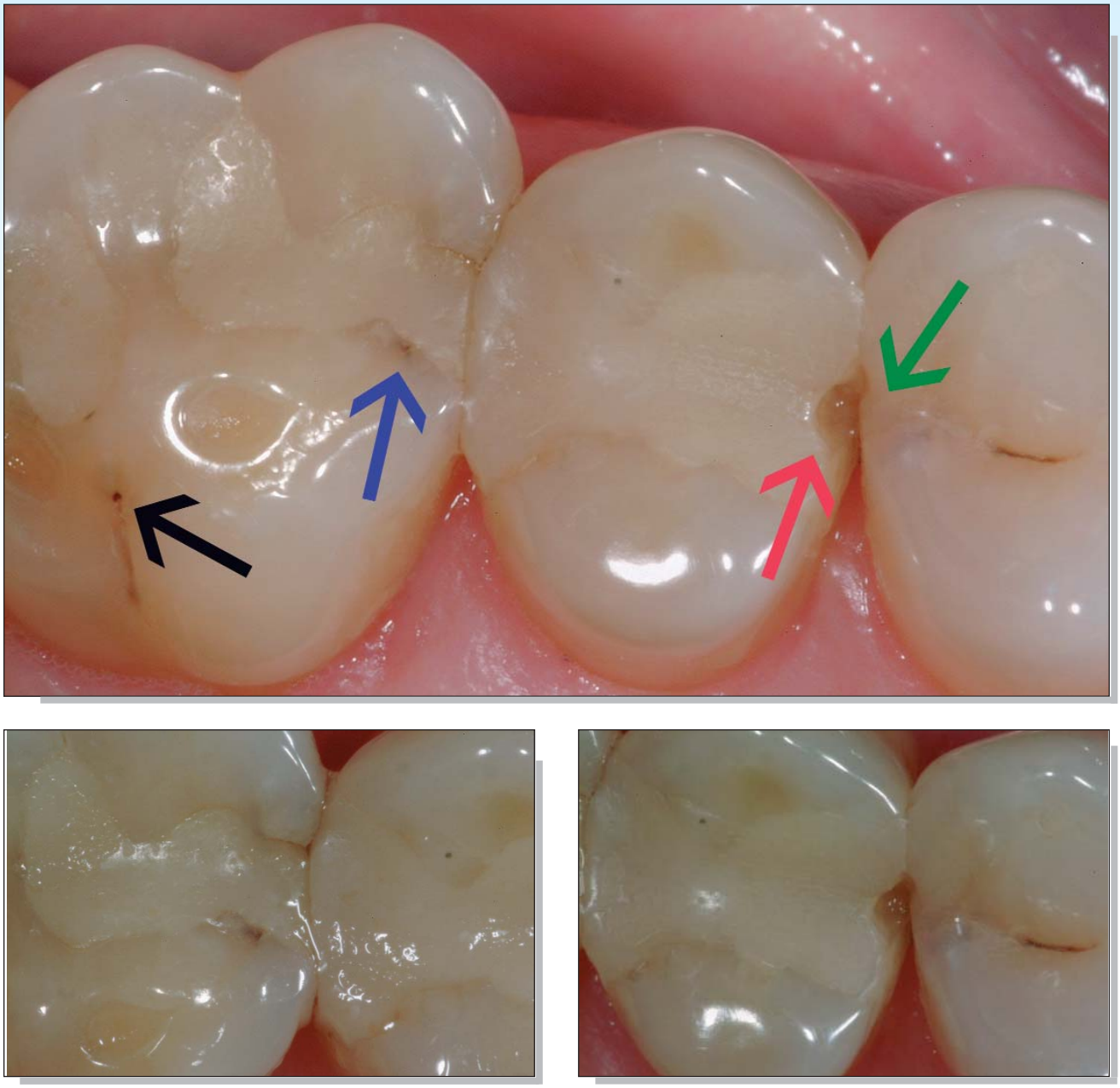

**Figures 1, 2, 3:** ***Fig 1***. **What's wrong with this picture? These recently placed posterior composites demonstrate the often-woeful state of direct composite restorative dentistry. Black arrow: A carious fissure was missed; lack of magnification was the likely culprit. Blue arrow: "Minimally invasive" Class II cavity shape creates impossible C Factor problems. Red arrow: Incremental loading leaves seams and voids that allow subsequent fracture. Green arrow: Proximal tooth was iatrogenically gouged and now has a carious lesion penetrating into dentin.** ***Figures 2 and 3*** **are higher magnification views of figure 1.**

*if amalgams are better, why are we doing posterior composites?"* The answers generally involve hand wringing, frustration, and lively debate.

Endodontists joke that posterior composites are the number one killer of pulps, that leaking composites are their "number one" referral source. Most studies have shown that Class I



and Class II composites have a significantly higher failure rate than do amalgam restorations.[1-4] The AMA, ADA, FDA, US Public Health service, CDC, NIH, and WHO have all declared amalgam safe.[1] In light of this evidence and overwhelming opinion, how can we in good conscience continue to place posterior composites? So let's ask one more time: *What's wrong with this picture?* Why are we content to provide a posterior composite restoration that essentially cripples the tooth in the name of esthetics, knowing that there is no proven systemic health benefit compared to amalgam? Many restorative dentists have simply given up on amalgam and composite and spend more than $100,000(US) for a CAD CAM unit. They choose porcelain inlays and onlays as successors to amalgam rather than struggle and compromise with posterior composites.

The current state of posterior composite restoration poses empirical arguments for amalgam or porcelain alternatives. But by the conclusion of this article I will provide two very good reasons why posterior composites can bless, rather than curse the tooth.

## The G.V. Black Era

To understand how clinicians can be influenced by a cultural and scientific icon, it is helpful to look at medical history. Claudius Galen was a Roman physician who boldly devised a medical model that doctors followed for fourteen centuries. Though his medical judgments were remarkably advanced for his day, today, not surprisingly, we know that most of Galen's theories and treatments were completely wrong, and that the rest were seriously flawed. In a parallel to Galen's example, G. V. Black was a consummate dentist/scientist and his exquisite designs for cavity preparation were a huge step forward for dentistry. Unfortunately, we are discovering today that those cavity shapes weaken the posterior dentition and lead to fracturing in even the most conservative applications.[5, 6] (Fig 4)

In a two-year study planned for future publishing; between 2001-2003 I utilized 16X magnification to evaluate each posterior tooth that was treated for retreatment of an amalgam or posterior composite. I classified and documented incomplete fractures. I found:

- *Sharp internal line angles are only a small part of the problem*
- *Joining the occlusal to the interproximal is the worst possible design for crack avoidance and the most common area for crack initiation*
- *Most fractures initiate in dentin at the line angles*
- *Interrupted cavities were more crack resistant than connected cavity preparations*

In the previous articles, I have highlighted the widespread problem of amalgam tooth preparations that predispose the tooth to fracture. One of dentistry's myths is that amalgam expansion causes tooth fracture. Expansion failures have never been proven. The fracture problem does not originate with amalgam, per se. It originates in iatrogenic GV Black **cavity preparations**. And just as many of us feared, we are seeing the same pattern of fracturing in teeth with posterior composites now that enough time has elapsed to assess their longevity.

## The Simonson Transition

Dr. Richard Simonson is widely recognized as a pioneer in new cavity preparation shapes for minimally invasive, bonded, resin-based posterior composites. In spite of his innovations, the GV Black preparations that I was taught in school 20 years ago have been only slightly modified for poste-

**Fig. 4:** Extracted bicuspid with a conservative G. V. Black Class II features classic iatrogenic fracturing pattern.

**Fig. 5:** The gingival margin in this class II composite demonstrates the pervasive problem of microleakage. There was unfavorable C factor at the margin, creating suck back. Uncured and contaminated flashing results from a metal matrix that blocks light curing and visualization.

**Fig. 6:** Case in Figure 5 is retreated with Clark Class II filling techniques and instruments overcoming multiple problems.

## *Table 1:* Problems associated with current posterior composite placement techniques

1. Composite is poor biological space filler. A biological space filler such as amalgam or gold foil does not require any adhesion to the tooth surface. Composite on the other hand must be sealed 360 degrees and from inside to out.
2. Unlike amalgam and gold foil techniques, "packing composite into a hole" is not a predictable method. Excellent clinicians have been dealt an unfair hand when it comes to Class II composites. Most of the features of the traditional cavity preparations such as parallel walls, resistance and retention form work against posterior composites. What we have observed at CRA and under the microscope is that polymerization shrinkage cannot be eliminated, only mitigated. The best margin is no margin, and when composite extends slightly past the cavo-surface margin, it is generally well sealed with no white line. When we polish back to the margin, the white line often appears. "Composite sealing" with thin resins applied after filling the cavity may reduce wear. However, trying to seal an imperfect margin after the fact is futile. As I have explored these white lines, they generally extend completely to the pulpal floor, far beyond the reach of a sealer.
3. C factor has been oversimplified by mainstream literature and remains a significant problem
4. Posterior composites should go "on" not "in" the tooth
5. Minimally Traumatic dentistry should be considered as an upgrade of "Minimally Invasive" dentistry. Well-meaning dentists are promoting minimally invasive dentistry. The best long-term outcomes are more important than the race to minimize the micrograms of tooth structure that are removed. For example, the "tunnel" style Class II preparation preserves the enamel of the marginal ridge but unnecessarily weakens the tooth and impedes clinical visualization. Incomplete caries removal combined with excessive tooth weakening are unacceptable casualties of the noble mission to save marginal ridge enamel.

rior composites in the typical dental practice and in most dental schools. Table 1 highlights problems with traditional posterior composite techniques. (Figs. 5, 6).

**The Fissurotomy™ and "Cala Lilly" Class I; The Clark Class II**

The Fissurotomy™ Class I, Cala Lilly Class I and the Clark Class II are fairly radical departures from GV Black's system of preparing and restoring posterior teeth. These new cavity designs are based on adhesive composite

## *Table 2:* The disconnected occlusal portion of the restoration can be:

- Small defects; Fissurotomy shaped
- Moderate lesion; Cala Lilly shape
- Large sized lesion or amalgam replacement; cusp tip to cusp tip Splinting Cala Lilly shape

restorative materials and engineered to resist tooth fracturing. (Fig 7a-c) The new primary goal of first-time interproximal caries restoration is to avoid connecting the occlusal to the interproximal, a concept that Simonson first advocated. The different sizes of the occlusal portion of the new Clark Class II cavity preparation are summarized in table 2.

**A new Fissurotomy technique (occlusal portion):** This new technique has five important components. First, the concept of "sealing over" caries and grossly contaminated pits and fissures is questioned, and replaced by exacting micromechanical

**Fig. 7:** Diagrams of the Clark Class II (5a), the slot preparation created by Simonson and others (5b), and the original G. V. Black class II (7c).

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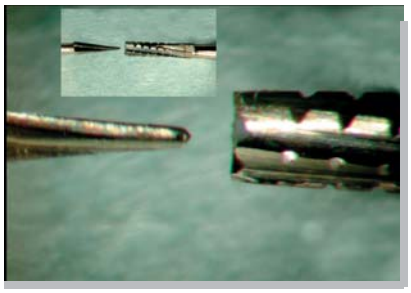

**Fig. 8:** 4X and 24X magnification comparing the tip size of the Fissurotomy™ NTF Bur versus a #556 fissure carbide. The tip size of the Fissurotomy™ NTF is easily ten times smaller. The width and length of the cut into dentin appear to be the most debilitating parameters predisposing posterior teeth to fracture. Sharp line angles (as produced by the #556 carbide bur) are not recommended for composite restorations. To allow for proper dispersion of the forces of mastication, all internal lines angles should be slightly rounded. Rounded internal line angles are created with the use of the Fissurotomy™ Burs. The Fissurotomy™ NTF Bur has the narrowest tip available for completion of these procedures.

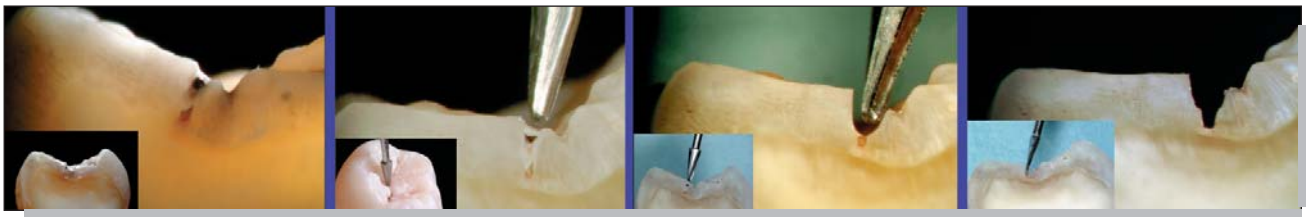

**Fig. 9a-d:** ***Fig 9a:*** Sectioned molar at 4X and 24X magnification reveals a serious enamel defect that extends very near the dentin. This insidious defect is a perfect example of the unpredictable nature of occlusal morphology. The deep groove full of biofilm and caries activity is not part of the central groove and is also at an oblique angle to the long axis of the tooth. ***Fig 9b-c:*** Initial penetration is achieved with the Fissurotomy™ Original Bur. The more aggressive taper on the 2.5mm cutting surface of this bur allows a conical access to the enamel defect. This shape affords proper visualization of the myriad of directions that are possible. The most insidious types are the lateral and cul-de-sac type of defects that are often not discovered when parallel-sided cuts are made, compounded by insufficient magnification. ***Fig 9d:*** Once the extent of the defect and or lesion is ascertained, the more delicate and less tapered Fissurotomy™ NTF Bur can be utilized to finish removing stain and bacteria.

instrumentation. Second, the size and shape of fissure preparation burs is completely modernized with the development of the Fissurotomy Bur system (SS White, Lakewood, NJ). Figure 8 contrasts the precision-engineered SS White Fissurotomy™ NTF Bur tip size with the standard #556 fissure bur. The #556 is unfortunately the most utilized operative bur in dentistry and is largely responsible for the current "epidemic" of cracked teeth. Today my protocol involves the use of both the Fissurotomy™ Original Bur as well as the more narrow Fissurotomy™ NTF Bur. (Fig. 9) Fissurotomy™ Burs are scientifically developed instruments for the diagnosis and treatment of hidden caries and should be utilized to create proper preparation form and function for the placement of composite restorations. The Fissurotomy™ NTF Bur is ideal for ultraconservative micro preparations of pit and fissure defects. The thin carbide tip of the Fissurotomy™ Burs will not "strip" quickly like thin diamonds. Third, each occlusal defect is addressed separately, wherein the clinician should avoid the temptation to "connect the dots". Fourth, the restorative material of choice is a robust, filled composite such as a flowable composite and/or heated paste composite. Fifth, the use of advanced clinical magnification ranging from 3.5X to 16X is imperative.

**The Cala Lilly (occlusal portion);** The Cala Lilly*, a beautiful trumpet shaped flower. (Fig 10) I use its name to describe the new cavity shape for medium to large sized Class I composites. Traditional parallel walled cavity preparations have not been shown to provide the adequate volume of enamel rod engagement. Compounding the problem is parallel cavity walls that do not afford proper angle of intersection of enamel rods to provide long term splinting of a posterior tooth.

**The Clark Class II (interproximal portion)** [Fig. 7] The goal of first-time interproximal caries restoration is to avoid connecting the occlusal to the interproximal, which is a concept that Simonson first advocated. The next evolution of this design is the saucer shape with serpentine/disappearing margins. The final change is discarding and replacing old filling techniques, matrixing systems and curing tech-

* The Cala Lilly Class 1 and Clark Class II will be detailed further in future articles and at the Minimal Intervention Dentistry Symposium , Vancouver BC on March 7, 2008.

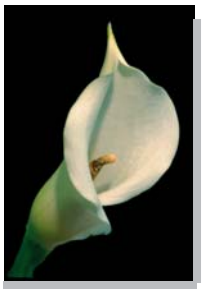

**Fig. 10:** The Cala Lilly is a graceful flower with an ideal shape to mimic for Class I cavity preparations. It allows tooth splinting when composite is carefully placed, it maximizes enamel rod engagement, allows perfect visualization of the cavity, and minimizes the potential for crack initiation.

**Fig. 11:** Preoperative view of an every day occurrence. A decade after amalgam was placed; the tooth is deteriorating as the fracture spreads.

niques.

Figures 8-13 demonstrate a clinical example of a combined Cala Lilly occlusal and Clark Class II interproximal. The beautiful first bicuspid in figure 8 is from a twenty-eight year old male. It shows an early incomplete coronal fracture, based on the magnified view of the mesial marginal ridge and according to the guide that we published in the *Journal of Esthetic and Restorative Dentistry* and most recently in *Dentistry Today*. Earlier in my practice, I would have turned this Class I (occlusal) amalgam one into a Class II or "MO" composite or amalgam, because I would not have seen the fracture undermining the buccal cusp that is not visible at less than 10X. In addition, I suspected but did not understand that turning this Class I into a traditional Class II with a mesial box form would further weaken this already iatrogenically compromised tooth. There is now a better approach, one that does not necessarily involve an indirect procedure such as a crown or onlay.

As we continue with the bicuspid in image 8, the occlusal is treated first, and a "Calla Lilly" shape that engages the bulk of the occlusal table is prepared and restored. (Fig. 9) The interproximal in this case is then addressed separately to simplify the process and to control C factor. Note the saucer shape on the mesial. (Fig. 10) This flattened cavity shape requires a completely new filling protocol and peripherals. Instead of metal sectional matrix bands, wedges and separators, we utilize transparent anatomic sectional matrix bands (*Bioclear Matrix System*™), translucent *Interproximators*™ and a single load technique with an injection molded process where resin, flowable composite and then paste are loaded in sequence without stopping to light cure the individual components. The restoration is light cured with one or multiple curing lights from occlusal, buccal and lingual with this fully translucent system. The result is a seamless, rounded restoration that delivers breathtaking results. (Fig. 11-13) Better is rarely faster in dentistry, but our test clinician's report both (better/faster) once they are past the learning curve.

## Can These Things Last?

Early posterior composites showed unacceptable wear. Microfills like Heliomolar™ had excellent wear resistance but mediocre strength.

**Fig. 12:** Composite placed in a traditional parallel walled cavity cannot "splint" the coronal tooth structure. In contrast, when the Calla Lilly shape is created, we will engage nearly all of the enamel rods of the occlusal surface. Note that the caries has followed the crack into the mesial interproximal.

Marginal ridge fracture was common. Many modern composites now exhibit excellent strength *and* wear resistance. In several studies, composite/enamel bonding has exhibited very lengthy in vitro success that does not deteriorate over time.[7] The key is that the initial bond must be exquisite and engage large areas of enamel, such as seen in enamel-based porcelain and composite veneers.

In an unpublished study, CRA scientists assisted me for an in office recall study. We documented patients with minimally traumatic Class I composite restorations that had been in service for three to seven years. These were restored Fissurotomy style (little or no dentinal caries) or moderate Cala Lilly (moderate dentinal caries) preparations. In 107 posterior teeth, 100 per cent of the composites were retained. Excess wear was present in some samples that utilized flowable composite alone. The combination paste/flowable cases showed the best wear resistance in SEM evalua-

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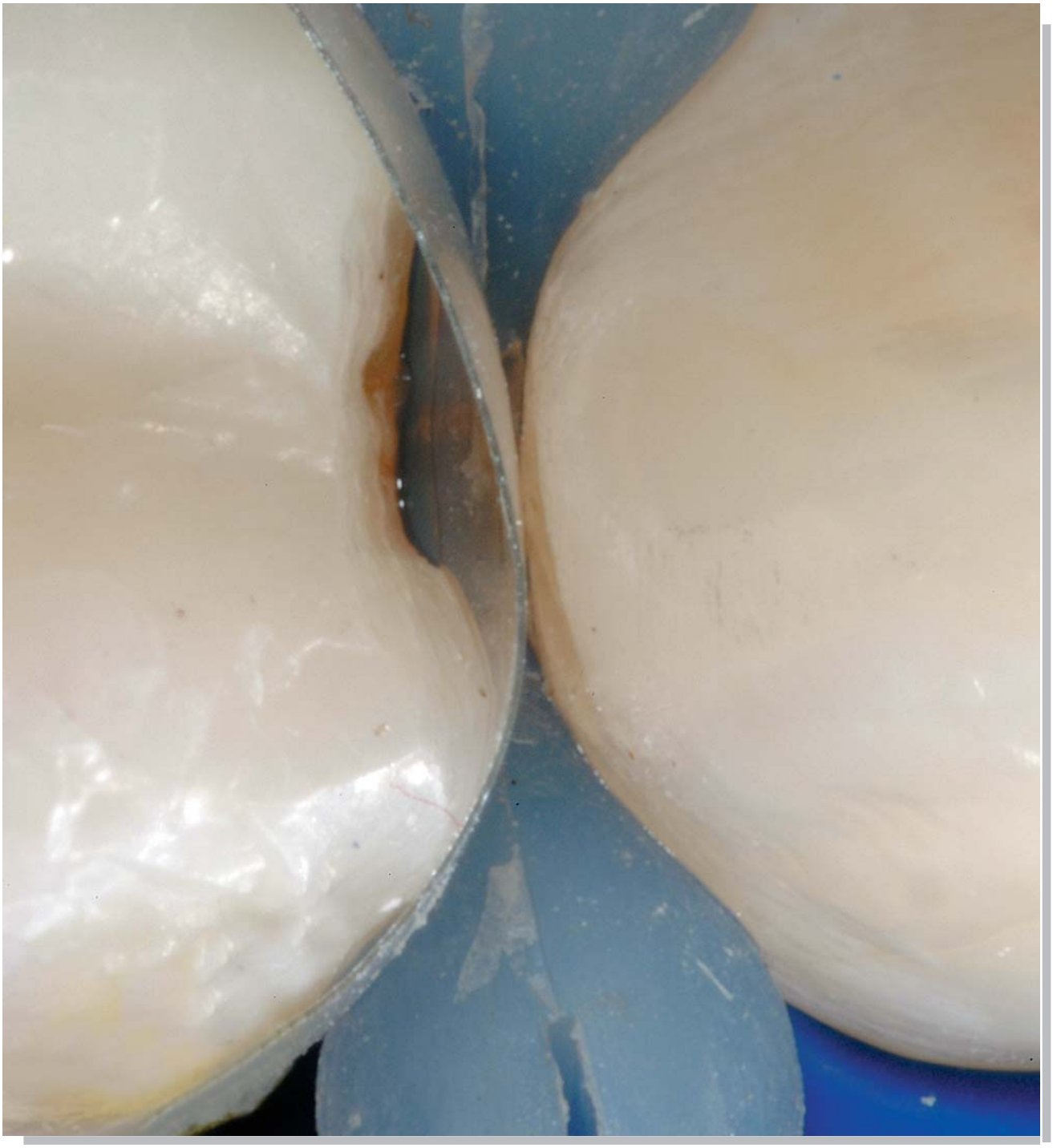

**Fig. 13:** Clark Class II is claustrophobic without magnification and unrestorable with conventional peripherals. With advanced magnification and new tools, we have new possibilities.

**Fig. 14:** Low magnification view of postoperative result

tion (Fig 14) and slight staining was present in less than 5 per cent of all samples.

## Summary

As we introduce the concepts summarized in this article to practicing dentists, they show a broad spectrum of responses from shock and disbelief to sheer exuberance. As these cavity shapes are implemented we will see a dramatic reduction in the rate of tooth fracturing. We also anticipate that

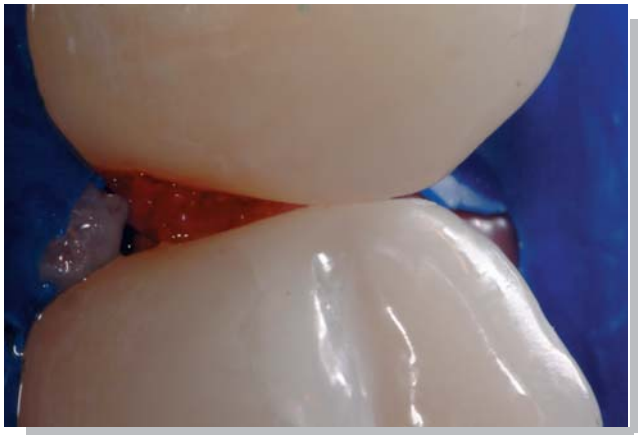

**Fig. 15, 16:** High magnification post-operative views.

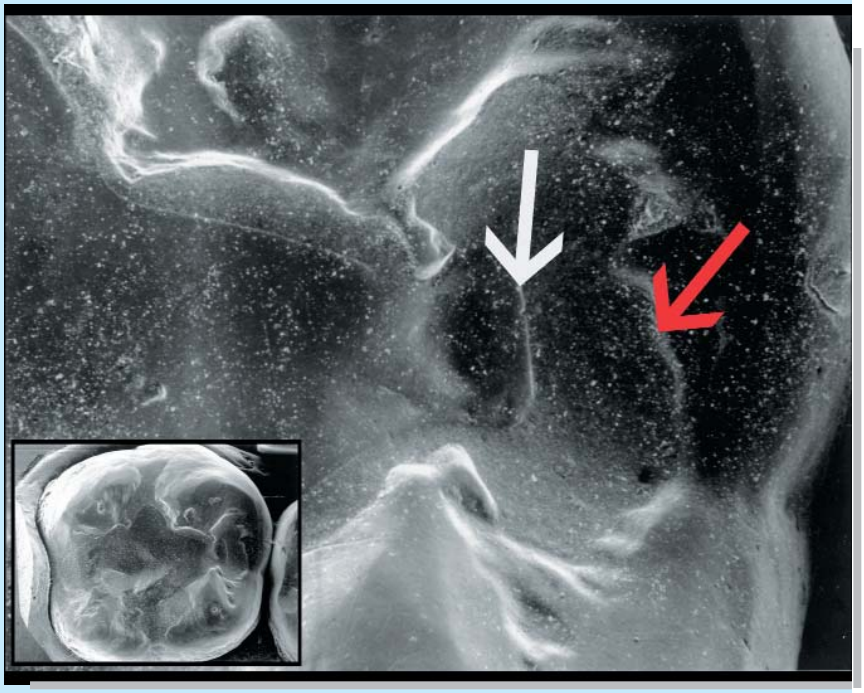

**Fig. 17:** SEM of three-year follow-up of one of my cases evaluated in the study. Filtek Supreme™ paste combined with flowable technique in a molar shows good wear resistance. White arrow shows paste composite/flowable composite interface. Red arrow shows flowable composite/enamel interface

## Introducing the Clark Class I and II Restorations

these restorations will outlast the Class II amalgams that have served so well in the past. This very brief article can only touch on the dramatic differences of this minimally traumatic and incredibly durable direct composite. A full instructional DVD, together with a textbook and hands on courses are available and recommended. The Cala Lilly Class I and the Clark Class II and injection-molded technique are intellectual property of the author patent pending and may be used solely with permission.

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**Disclosure:** *Dr. David Clark has financial interest in several of the products mentioned in this article.*

Educational material and the Bioclear Matrix System are available at **www.bioclearmatrix.com**

Fissurotomy Burs and associated educational material is available from SS White at **www.sswhiteburs.com**