

# A Clinical Presentation of the Direct Gold/Composite Sandwich Restoration

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## Clinical Relevance

Studies indicate the failure of posterior composite restorations, where bonding to dentin is required, continues to be an issue. The results are leading to the need to replace and/or repair existing restorations earlier than has been the experience using traditional restorative materials.

## SUMMARY

The intent of this paper is to present a new idea for increasing the life expectancy of class II composite restorations where the proximal marginal seal is compromised by the necessity to rely on dentin bonding. As implied by the Clinical Relevance statement, studies show that bonding to dentin in areas with high levels of bacterial action, combined with sustained high plaque formation, tends to be the “Achilles heel” with regard to sustained long-term restorations. Therefore, this paper will present a thought experiment, combined with clinical evidence, for combining gold foil with composite in these areas for the class two composite restoration. The results, if proven viable, will be to develop a procedure utilizing the properties of

gold foil that make it one of the longest-lasting restorative materials with the recent development of modern cosmetic materials for a truly long-lasting and healthy class II restoration.

## INTRODUCTION

The results of relying upon dentin bonding in proximal and subgingival areas have shown decreased longevity for class two composite restorations as compared to previous restorative materials used in the past 80 years.<sup>1-6</sup> The results suggest the need to replace and/or repair existing restorations earlier than has been the experience when using traditional restorative materials.<sup>5,6</sup> The central problems arise from leakage and subsequent breakdown of the bond at the gingival and subgingival dentinal margins for class 2 and class 5 procedures (personal correspondence between Dr Lloyd Baum and Dr Giancarlo Gallo).<sup>3,4,7</sup> Due primarily to bonding properties associated with the organic and water composition of dentin being at 50% as compared to 12% for enamel, dentin bonding characteristics are not ideal for long-term durability.<sup>1-9</sup>

The clinical use of gold foil to seal dentin margins in class 2 and class 5 gingival prep areas has proven to be one of the most predictable restorative techniques with a long history of success.<sup>5,10-12</sup>

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The properties of gold foil indicate it is an ideal material to both create a seal and maintain that seal over time in the gingival and subgingival environments encountered in class 2 and class 5 restorations.<sup>13-16</sup> These properties include: (1) a marginal fit approaching 1 micron, (2) a coefficient of expansion close to tooth structure, (3) no corrosion, and (4) an oligodynamic effect. The first three are important; and when combined with the oligodynamic effect of interfering with cell membrane transport, one has a material with a disinfecting property when placed in areas where pathogenic organisms can lead to margin failure.<sup>5,6,13,14,16-18</sup>

This paper describes a clinical restorative technique to address the limitations of dentin bonding in the class 2 composite dental restoration. It is a procedure that combines the proven long-term application of gold foil with the cosmetic aspects of composite resin by removing the need to bond to dentin in the proximal box, where leakage and breakdown occur at an accelerated rate due to dentin bonding issues. In addition, this is a clinical presentation and will not engage in debate about the use of available direct gold options or the use of different composites/bonding techniques. It is a first look at the possibility for combining two proven materials and techniques utilizing the long-term sealing ability of gold foil and the long-term enamel bonding ability of composite for the benefit of patients.

### A CLINICAL DECISION PROCESS

Approximately eight years ago, while completing class 2 foils in my private practice, there was an emergency patient who needed immediate care. The interruption necessitated the need to temporize the two class 2 foils that were approximately at mid-completion (Figure 1). The proximal boxes in both foils had been completed. Both proximal boxes were filled with E-Z Gold (Lloyd Baum Dental Center, Loma Linda, CA, USA) to the level of the occlusal floor in the preparation. E-Z Gold is the author's choice for bulk fill when doing a gold foil. Due to the ease of use and faster build up, E-Z Gold is the gold of choice within a busy private dental practice where gold foil is routinely placed. The E-Z Gold is veneered with #4 gold foil when the restoration is to be completed with direct gold.

In this case, to temporize the restorations, the foil was micro etched with 50-micron aluminum oxide then completed utilizing a total etch (Ultra-Etch, Ultradent, South Jordan, UT, USA) and resin bonding (3M Universal Scotchbond) material to the remaining tooth structure and the micro-etched foil. A posterior composite (3M Silux Plus) was used at that time to complete the restoration. (Figure 2) The patient was to



Figure 1. Two class 2 foils in tooth 4 (2012).

return for removal of the composite and completion of the foil later. However, the patient did not return for six months, at which time the restoration was evaluated and found to be doing well clinically. The decision was made not to replace the composite. The restoration is now six to eight years in function. No clinical photos exist.

Following the original restoration and upon discussions with Dr Clyde Roggenkamp of Loma Linda, CA, it was discovered that Dr Lloyd Baum had conceived of the idea for combining foil and composite and had discussed this with his friend Dr Giancarlo Gallo of Italy. Thanks to Dr Roggenkamp, the correspondence from 1992 to 1997 between Dr Lloyd Baum of Loma Linda University and Dr Giancarlo Gallo of Alba, Italy, was forwarded for review. Their discussion centered around the concept of utilizing a sandwich technique combining gold foil and composite



Figure 2. Final restoration of foil and composite in tooth 4 (2012)

resin for the class 5 restoration. Their designs can be seen in the hand drawings from their correspondence in Figure 3 (reprinted with permission from Dr Roggenkamp).

Combining what was learned from Dr Baum and Dr Gallo, a refinement of the technique was developed to be applied to a class 2 foil restoration. The refinements included micro etching the gold and remaining prep with 50-micron aluminum oxide, then applying Metaltite (Tokuyama Dental America, Inc, Encinitas, CA, USA) to the gold via manufacturer's directions. Metaltite MTU-6, a thiouracil monomer, which, according to the manufacturer, "enhances a tenacious chemical bond between resins and precious metals" (Figure 4). In addition, it was decided to place E-Z Gold into the proximal box of the class 2 prep to the level of the occlusal floor of the prep to create the contact in gold for the final restoration (Figure 1).

The author's reasoning for the procedure was to enhance the longevity of posterior composite class 2 restorations by utilizing the properties of E-Z Gold for stabilization of the proximal area and the adjacent contact over time. The result is a restoration that combines the use of E-Z Gold in the proximal box to facilitate longevity with the aesthetic appeal of



Figure 4. Metaltite by Tokuyama Dental America Inc.

composite where effective bonding to enamel has been proven. This restorative combination takes into consideration concerns that the patient, the operator, or both might have with the cosmetic appearance of gold in areas where it can be seen during normal function. Also, it is hoped that this paper could begin to re-assert the value of utilizing direct gold to enhance the so-called "bondodontic" explosion within dentistry and prioritize restorative outcomes and longevity in selecting restorative options.

## CLINICAL CASES

Three cases are presented; first a class 2 DO/MO in a maxillary second bicuspid (Figures 1-2). The second case is a DO class 2 on tooth 13 (Figures 5-13). The third case is a DO class 2 on tooth 4 (Figures 14-23).

## CLINICAL PROCEDURES

### Clinical Case 1: Class 2 in Tooth 4, DO and MO Class 2 Foil-Composite Sandwich

As stated previously, the class 2 foil was terminated at the point of completion of the gold placement in the proximal boxes of both class 2 restorations in tooth 4 (Figure 1). The photo shows the completion of E-Z Gold placement in both proximal boxes and the placement of a GI liner proximal to the gold.

Following this, the gold was micro etched with 50-micron aluminum oxide, washed and dried, then a total etch with 35% phosphoric acid (Ultra-Etch, Ultradent) then bonded with 3M Universal Scotchbond (3M Oral Care, St Paul, MN, USA). Finally, 3M Silux Plus (repeat manufacturer's name here) composite was

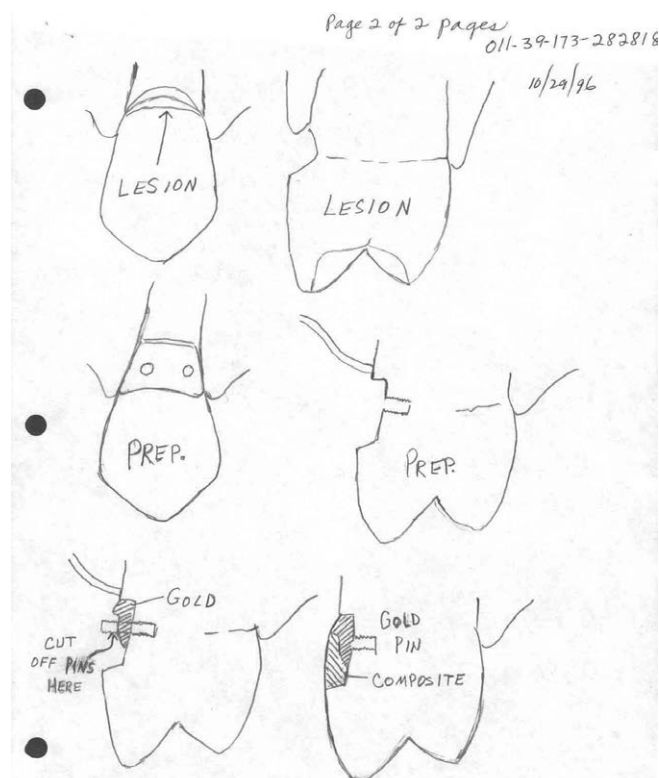


Figure 3. Original drawings from correspondence between Dr Lloyd Baum of Loma Linda University and Dr Giancarlo Gallo of Alba, Italy.



used to complete the restoration. This procedure was originally intended to be a temporary fix (Figure 2).

Following reevaluation of the restoration, it was decided to continue using the procedure with the modifications of adding Metaltite (Tokuyama Dental America, Inc) to increase bond efficiency between gold and composite resin plus filling the proximal box with E-Z Gold to ensure no dentin bonding and to make the contact in gold. All personal observations are from the author's private practice.

### **Clinical Case 2: Class 2 DO #13 Foil-Composite Sandwich**

The procedure consists of removing all caries, then filling voids created with GI (3M ESPE Fil Quick Aplicap (Need manufacturer's name and location unless same manufacturer has already been noted). This is followed by preparing a classic class 2 preparation for placing gold foil or amalgam under a rubber dam (Figures 5-13).

The initial penetration into tooth 13 was with a 169 bur (Brasseler) to determine the extent of the carious lesion (Figure 5) This was followed by removal of all caries. Healthy tooth structure is not removed; therefore, Black's rules are not observed at this point.



Figure 5. Initial bur penetration into carious lesion distal-proximal on tooth 13.



Figure 6. Distal box filled with EZ Gold, also showing the glass ionomer liner located proximally.

Following the insertion of the GI the preparation is completed to Black's specifications.

Figure 6 shows the placement of the remaining glass ionomer for the deep caries destruction and the final prep with E-Z Gold placed in the proximal box. The glass ionomer proximal to the foil acts as a liner and thermal insulator in cases where deep caries penetration into the dentin occurs (Figure 6).

A dead-soft Tofflemire matrix band is placed (HO Band), wedges inserted, and the band is burnished prior to placement of E-Z Gold (Lloyd Baum Dental Center) into the proximal box. In placing class 2 foils, the author normally uses no band (Figure 16, Case 3). However, a brass T band can be used as well, depending on the situation. Following the placement of E-Z Gold to the level of the occlusal floor of the prep (Figures 6-10), the foil and remaining tooth structure were micro-etched (Figure 7), utilizing a chairside micro etcher and 50-micron aluminum oxide.

The preparation and gold were then washed and dried to clear the aluminum oxide prior to etching. In addition, the prep was treated with 2% chlorhexidine (Consepsis, Ultradent) for 60 seconds prior to total etch. A total etch with 35% phosphoric acid for 30 seconds was completed. In this case, Ultra-Etch by Ultradent was used.

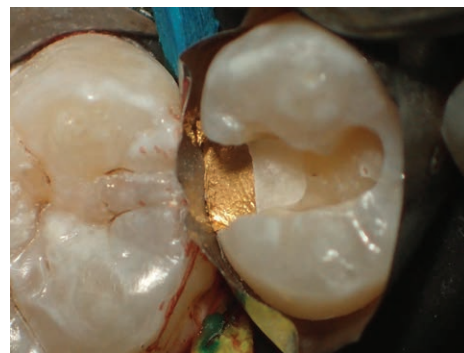


Figure 7. Foil and prep after micro etching with 50-micron aluminum oxide.



Figure 8. Foil treated with two layers of metaltite metal bonding resin.



Figure 9. Initial layer covering gold with shade A2.5 3M Filtek flowable composite.



Figure 10. Middle layer of shade A-2 3M Filtek flowable composite.



Figure 11. Final layer of shade A-1 3M Filtek flowable composite.

These steps were followed by applying Metaltite (Tokuyama) via a micro brush to the gold only (Figure 8). Manufacturer's directions were followed with air drying of one-two layers of Metaltite. Again, the procedure was completed under rubber dam.

Following the treatment of the E-Z Gold with Metaltite, 3M universal bonding was applied to the complete prep and cured. Next, 3M Filtek flowable composite was layered into the final preparation and cured in multiple increments until the restoration was completed (Figures 9-12). A darker or more opaque shade of composite was used in the first layer to mask the color of the gold, in this case, Shade A-2.5 (Figure 9). Finishing of the composite was completed using increasingly lighter shades layered and cured (Figures 9-11). Polishing points



Figure 12. Completed DO class 2 foil/composite sandwich on tooth 13.



Figure 13. Radiograph showing the placement of the foil in the proximal box distal on tooth 13.

and 3M disc and finishing diamonds were used to shape and finish the final restoration (Figure 12). Figure 13 is a radiograph showing the class 2 foil placement in the gingival 1/2 for the completed foil/composite sandwich restoration in tooth 13. The presence of a GI liner can be visually differentiated beneath the composite as well. There appears to be a small radiolucency within the GI. It is not known if this is an artifact or a small void. Because damage to the foil would likely occur with removal and replacement of the GI, it was decided to watch over time.

### Case 3: DO Virgin Caries Tooth 4

A penetration cut with a 169 bur (Brasseler) showing proximal caries at DO 4 is shown in Figure 14. This is followed by Figure 15, showing the placement of GI following complete caries removal. Figure 16 shows the final DO prep ready with E-Z Gold in place. In this case E-Z Gold was placed without a matrix band. This is the usual procedure when class 2 foils are completed by the author. This ensures maximal contact and gives better access to the proximal gingival floor for gold placement. After finishing of the gold contact utilizing VisionFlex Diamond Strips (Brasseler) a dead soft matrix band was placed prior to micro etching (Figure 17). This was to prevent etching the adjacent tooth or restoration.





Figure 14. DO 4 169 bur penetration to see caries.



Figure 15. DO 4 caries removed and GI placed prior to final prep.



Figure 16. DO 4 With EZ Gold Placed to the Level of the Occlusal Floor of Prep Creating the Contact in Gold. Gold Placed Without Matrix Band to Ensure Easier Access to Gingival Margin and a Tight Contact.

Figures 18 and 19 show the micro etching of the gold and prep followed by treating the gold with Metaltite (Tokuyama). Figures 19 through 22 show the placement of the composite bonding and layers of 3M Filtek flowable composite. A final veneer of compactable composite can be used in heavy occlusion cases.

Figure 23 shows the final radiograph of the DO restoration with the placement of foil, GI, and composite.

## CONCLUSIONS

This presentation is intended to be a thought exercise to demonstrate one possible solution to improving the success for class 2 posterior composite resin procedures.



Figure 17. DO #4 micro etched with 50-micron al oxide and dead soft matrix band used to prevent micro etch 3 and control composite placement. contact is already established in gold.



Figure 18. DO 4 treated with two layers of Metaltite (Tokuyama).



Figure 19. First layer shade 3.5 to cover the Gold 3M Filtek.



Figure 20. Second layer flowable shade 2.0 applied and cured (3M Filtek).



Figure 21. Final layer a-1 laid in and cured (3M Filtek).



Figure 22. Completed restoration DO 4 foil-composite sandwich.



Figure 23. Radiograph showing completed gold GI composite DO 4.

More research is needed, especially to observe what is happening at the bond interface between the composite resin and gold. A comprehensive evaluation of the overall success of adding foil to this procedure would also be beneficial. This is a project that should be completed in an academic setting. Obviously, anyone attempting this procedure is expected to be proficient in the placement of gold foil in a clinical setting. A start would be to contact the American Academy of Gold Foil Operators. The author is also personally available for comment.

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### Conflict of Interest

The author of this article certifies that he has no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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