

Conservative Cast Gold Inlays

An excellent option for longevity and esthetics in 2020 and beyond

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The phrase “the gold standard” is often used in reference to something that has been proven over a significant amount of time to be “the best.” In dentistry, there have been many restorative materials that have been used throughout the past 50 years. Silicates, amalgam, porcelain, composites, and other materials have had their place in dentistry, but in many ways, none of them have been able to measure up to the clinical restorative track record of gold. Cast gold has literally been “the gold standard” for years (Figure 1). For many dentists, it is the material of choice to use in their own mouths.¹ During the past 10 years, new materials have been introduced, lithium disilicate and zirconia in particular, with accompanying bonding protocols that have taken dentistry by storm.² Have lithium disilicate and zirconia become the new “gold standard” restorative materials? Many believe that they have; however, there is little data available regarding their longevity. Some of these materials have already proven to be clinically excellent regarding strength and esthetics, but only time will tell if they can achieve similar longevity to what has been documented with gold castings.

For a long time, gold was considered to be the esthetic restorative material of choice for posterior teeth because it was in many ways less objectionable than other restorative



(1.) Finished inlays of teeth Nos. 11 (distal-lingual), 12 (distal-occlusal), and 13 (mesial-occlusal) that were placed during a Tucker study club in 2006 under Tucker’s guidance.

materials.³ However, in recent years, esthetic/cosmetic dentistry has become a major focus of patients, dentists, and dental marketing companies. With this change in focus to emphasize esthetics, the ability of a restorative material to blend with the natural tooth structure has become the predominant consideration. Regarding preparation design, retention, resistance form, precise taper (ie, approximately 6° to 10°), sharp internal line angles, and beveled margins were replaced by smooth, rounded internal line angles, additional taper, increased occlusal reduction, and chamfer or butt margins that are kept in enamel when possible.

This article examines the benefits of cast gold restorations, the necessity of getting the proper training, and the importance of using

a predictable protocol. It also discusses why dentists should be offering cast gold restorations to their patients and how they can be used in combination with other treatments to achieve both longevity and esthetics.

Advantages of Gold

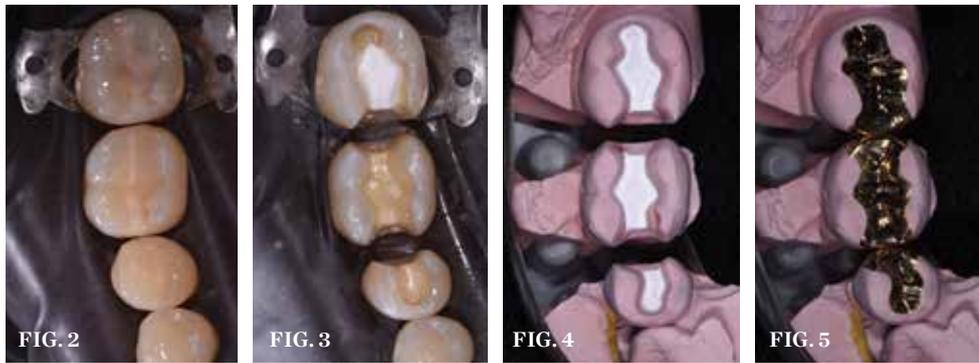
One may ask why gold castings should be considered in 2020. To answer in one word: longevity. There is no other dental material/technique that has exhibited the longevity demonstrated by cast gold restorations. Richard V. Tucker, DDS, was considered by many to be a true master of cast gold restorations, and although he passed away in 2016, his teachings and techniques live on through his study clubs. The Tucker technique (Figure 2 through Figure 6) for cast gold restorations “is a systematic clinical discipline with very specific steps. Each step must be completed before beginning the next. The overall goal is a conservative preparation with a smooth and flowing outline form, precise and even taper of all walls, and very sharp margins. Attention should be placed in attaining adequate draw, flare, and depth as well as sufficient resistance and retention form.”⁴ When all of the steps are properly accomplished, a well-trained laboratory technician will be able to construct an ideal casting that can easily be cemented, finished, and polished.

In 2004, Terry Donovan, DDS, published a retrospective clinical evaluation of cast gold restorations that had been placed by Tucker.⁴ Of the 1,314 castings that were evaluated, there was a 94.5% survival rate, and 72% had been in the mouth for more than 20 years. If contemporary luting agents had been available, would the survival rate of these restorations have been even higher?

Warren Johnson, DDS, who has mentored several of the Tucker study clubs, demonstrated the excellent margination that can be



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(2.) Preoperative photograph of failing composite restorations on teeth Nos. 29, 30, and 31. (3.) Final preparations for teeth Nos. 29 (distal-occlusal), 30 (mesial-occlusal-distal), and 31 (mesial-occlusal). (4.) Preparation model. (5.) Finished gold castings on the model. (6.) Post-operative photograph of the finished quadrant of cast gold inlays.

achieved with cast gold. Using an extracted tooth, he followed the Tucker technique to seat a gold inlay with zinc phosphate cement and then finish it (Figure 7). He then took scanning electron microscope (SEM) images and measured the gap at the gold-tooth interface, which was 314 Nm (Figure 8 and Figure 9).⁵ When compared with the gap at the lithium disilicate- or zirconia-tooth interface, especially considering the size of average bacteria, the margins that can be achieved with cast gold are extremely impressive (See Table 1).⁵⁻⁸ It seems logical to consider that the incredibly small gap at the restorative-tooth interface that is achieved using the Tucker technique may have something to do with the longevity associated with cast gold restorations that was documented in the Donovan evaluation. The following case demonstrates how cast gold restorations can be esthetic when conservatively placed.

Case Report

A 34-year-old, female patient presented to the practice, frustrated because she did not

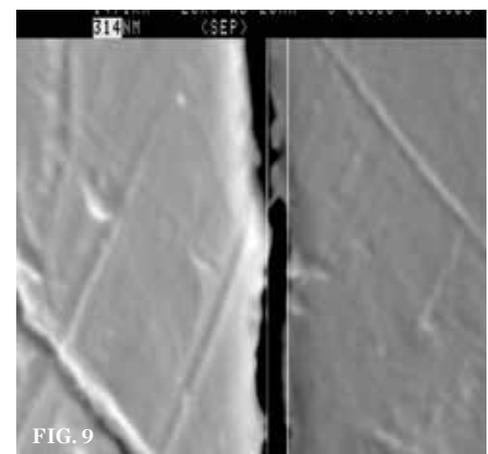
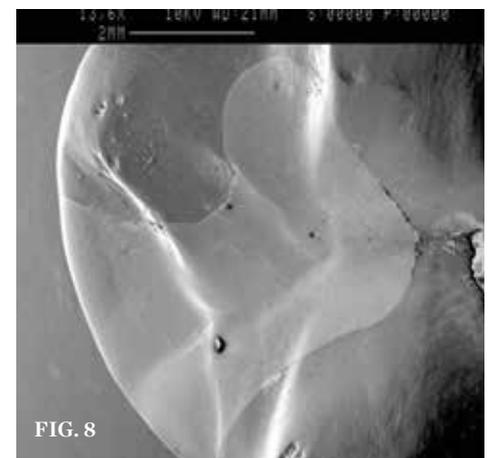
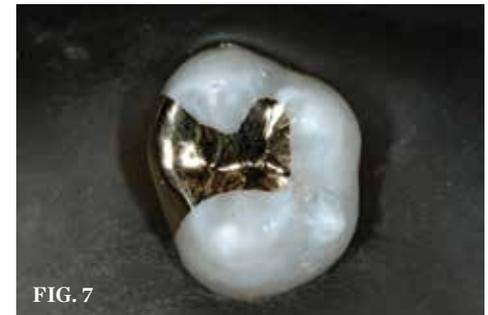
like the appearance of her teeth. In addition, she was getting food caught between her teeth and was experiencing chipping (Figure 10 through Figure 12). She had undergone significant restorative dentistry in previous years and was frustrated by the constant need to replace these restorations because of decay, leakage, or fracture. Having done some research prior to presenting, she was interested in finding a clinician who was proficient in restoring with gold because she had heard about its longevity. The patient indicated that she had reached a point in her personal dental experience where she was willing to put in the time and allocate the necessary finances to have restorations placed that were as permanent as possible.

Intraoral and radiographic examinations were performed, which revealed the presence of decay on the mesial-lingual aspects of teeth Nos. 2 and 14, on the mesial aspect of tooth No. 4, on the distal aspects of teeth Nos. 5 and 12, and the on the lingual aspect under the crown of tooth No. 13. The patient was also experiencing food impaction between

TABLE 1. Indirect Restorative Marginal Gap Comparison⁵⁻⁸

Restoration	Average Marginal Gap (μm)
Lithium disilicate (pressed)	38 μm (± 12)
Lithium disilicate (CAD)	45 μm (± 12)
Zirconia	44.2 μm
Tucker finished gold casting	0.314 μm (ie, 314 nm)

Note: average size bacteria = 0.2 μm to 10 μm



(7.) Finished gold inlay seated on an extracted tooth with zinc phosphate cement. (8.) SEM image of the occlusal view of the extracted tooth and gold inlay. (9.) SEM image of the marginal gap between the gold inlay and tooth structure.



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FIG. 10



FIG. 11



FIG. 12

(10.) Pretreatment smile photograph. Note the flaring and rotation of the maxillary lateral incisors and the chipped incisal edges of the maxillary central incisors. **(11.)** Pretreatment occlusal view of the maxillary arch. Note the crowding of the maxillary anterior teeth and how tooth No. 13 was pushed buccally. **(12.)** Pretreatment retracted view with the teeth apart. Note the crowding and chipping of the maxillary and mandibular anterior teeth.

teeth Nos. 4 and 5 due to an open contact as well as between teeth Nos. 18 and 19 due to a distal-buccal composite restoration on tooth No. 19 that had chipped. Finally, there was a small chip on the lingual aspect of the porcelain crown on tooth No. 15.

Different treatment options were discussed, including the advantages of gold castings and how they can be designed to avoid a significant display of gold. Although gold castings are not tooth-colored, cost more than other restorative materials, and require significant skill and technique from the operator, their advantages are considerable. Gold castings will not break, fracture, exhibit marginal wear or discoloration, or abrade the opposing dentition.³ They have a coefficient of thermal expansion that is similar to that of natural tooth structure, can be cemented or bonded, enable the formation of ideal proximal contacts, finish very smoothly, facilitate tissue health, wear similarly to natural teeth, and most of all, demonstrate longevity.³

The patient was referred for orthodontic treatment in order to address the crowding of both the maxillary and mandibular teeth, increase overjet, and intrude teeth Nos. 22 through 27. Prior to orthodontic treatment, the decay was removed, a temporary crown was placed on tooth No. 13, and temporary fillings were placed on the remaining debrided areas. The patient was questioned about her diet and then educated about related factors that could be contributing to the condition of her teeth. In addition, she was prescribed a low abrasion tooth gel (CTx4 Gel 5000, CariFree) to routinely use before bedtime and told to drink tap water after every meal or snack

to help rinse the acids off of her teeth and raise the pH of her mouth.⁹

After 10 months of orthodontic treatment, the patient returned to the office for further consultation regarding restorative treatment. A treatment plan was devised that would brighten and enhance her smile while also restoring her posterior teeth as permanently as possible. First, the patient completed 2 weeks of vital tray bleaching using her postorthodontic retainers with a small drop of carbamide peroxide tooth whitening gel (Opalescence[®] 10%, Ultradent Products, Inc.) for 2 hours a day.¹⁰ She was able to brighten her teeth from shade A3 to A1. They looked noticeably whiter, and the patient was pleased with the result.

Next, the focus shifted to treating her maxillary posterior teeth. Using the Tucker technique for cast gold restorations, taking special care to keep the occlusal outline forms inside of the cusps, the teeth were prepared for gold inlays with the exception of teeth Nos. 13 and 15, which were prepared for a lithium disilicate crown (IPS e.max[®], Ivoclar Vivadent) and a full gold crown, respectively, to replace the existing crowns.

The Tucker technique for the placement of a quality cast gold restoration involves a specific series of steps that includes, “diagnosis, tooth preparation, impressions, models, wax-up, investing, casting, cementation, and finishing. A flaw in any one of these steps or lack of attention

“When compared with the gap at the lithium disilicate- or zirconia-tooth interface, especially considering the size of average bacteria, the margins that can be achieved with cast gold are extremely impressive.”

to the finest detail would result in failure or an unsatisfactory result. The single step which contributes to a large number of failures, and that which requires a special effort from the operating dentist is the cavity preparation.”¹¹ If the step-by-step method for preparation is understood and can be followed for a single tooth, then the method can also be applied and utilized for quadrant restorative dentistry, as was done in this case. The patient’s upper left quadrant was prepared,

and an impression was taken. At the next appointment, after seating the restorations in the upper left quadrant, the upper right quadrant was prepared, and an impression was taken.

As demonstrated by the outlined preoperative photograph (Figure 13), some of the old composite restorations were fairly extensive; therefore, the goal was to prepare the previously restored teeth as conservatively as possible—including the isthmus width and gingival and axial depth—while satisfying all of the preparation requirements (eg, draw, flare, resistance, retention, depth) and creating a flowing outline for every restoration. The resulting outline forms were kept inside of the cusps, and the preparations were not extended out to the visible areas of the teeth

Careful impressions and laboratory work resulted in the creation of some fine-fitting gold castings. After the seating of the inlays, all of the accessible margins were finished using a series of sandpaper discs (ie,

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(13.) Pretreatment occlusal view of the maxillary arch with the existing composite restorations outlined. (14.) Final posttreatment occlusal view of the maxillary arch. Note the similarity between the outlines of the gold inlays and the previous restorations (indicating conservation of tooth structure), the realignment of the anterior teeth, and the movement of tooth No. 13 lingually. (15.) Final posttreatment smile photograph.

medium garnet, fine sand, fine cuttle). The discs were slowly rolled across the margins from gold to tooth, reducing the level of the gold until it was on the same plane as the tooth structure and closing the marginal gap by burnishing and pulling the gold. After the finishing was completed, final polishing was performed using a series of polishing powders to achieve a beautiful luster (Figure 14). When the finished upper-arch photograph is compared with the preoperative photograph, it can be visualized that the final outlines of the gold castings are very similar to those of the old composite restorations, which demonstrates that as much tooth structure as possible was conserved.

Finally, with attention to detail and a conservative composite bonding protocol, a predictable long-term esthetic result¹² was achieved for the patient's anterior teeth. Adding to these teeth (ie, Nos. 6, 7, 8,

“Tucker emphasized the discipline and attention to detail that it takes to prepare, seat, and finish a fine gold casting. Through study clubs, his teachings, techniques, and cookbook approach to gold castings have been passed on to thousands of dentists.”

9, 11) developed symmetry and allowed the incisal edges to follow the curvature of her lower lip (Figure 15). The patient expressed her satisfaction with the final result, which was a beautiful, pleasing smile with no gold on display.

Discussion

In this case, a combination of conservative treatment protocols was employed to minimize the need for further tooth reduction and achieve the final result. The protocols included orthodontics to get the teeth in their proper positions, tray bleaching to brighten the remaining tooth structure before restorative procedures, composite bonding of the anterior teeth to enhance their esthetics, and finally, conservative cast gold restorations to restore the maxillary posterior teeth.

To satisfy the desires of this patient, the treatment plan was designed with both longevity and esthetics in mind, but which is more important? The answer is in the eye of the beholder. For some patients, longevity will trump esthetics or vice versa, but for other patients, they are equally important. The only way to know for sure is to go beyond merely providing an exam and have a conversation with patients. Healthcare providers are obligated to perform thorough examinations and then discuss their findings with patients. It is also their responsibility to educate patients about their needs and discuss possible treatment options for any significant issues. By setting aside time to show patients intraoral photographs of their mouths, discussing treatment alternatives with before-and-after photographs, and giving them enough information that they can make educated decisions, clinicians enable patients to give informed consent on the treatment of their choosing.¹³ Yes, it is appropriate for the dentist to offer his or her opinion of what would be best in a given situation, but ultimately, it is the patient's decision.

Tucker emphasized the discipline and attention to detail that it takes to prepare, seat, and finish a fine gold casting. Through study clubs, his teachings, techniques, and cookbook approach to gold castings have been passed on to thousands of dentists who have applied them properly to achieve predictable, excellent results. Oftentimes, these skills, this discipline, and the conservative nature of gold castings carry over into other areas, improving a clinician's dentistry

overall. In this regard, it could be argued that the training and skill of the operator has as much to do with the clinical longevity as the choice of restorative material.

Conclusion

The moral to this story, as John Kois, DMD, would say, is that “you have to show the patient the menu.” Practitioners need to take the time to educate patients about their restorative needs, what the restorative alternatives are, and the corresponding advantages and disadvantages of the materials involved.

Cast gold restorations deserve to be on the restorative material menu. Regarding the longevity of gold castings, Tucker notes that they “are usually relatively permanent. We often see gold restorations that have been in service for 40 or 50 years. The permanence of gold fillings is the most obvious reason for their use. If there was a ‘lifetime’ restoration, gold casting would be it.”³

Ultimately, cast gold restorations may not be the choice of a majority of patients, but if the necessary time is taken to become proficient at using the Tucker technique, gold

restorations are put on the menu as a treatment option, and patient education is provided about the advantages of gold, plenty of patients will choose them—even in the year 2020 and beyond. 🍷

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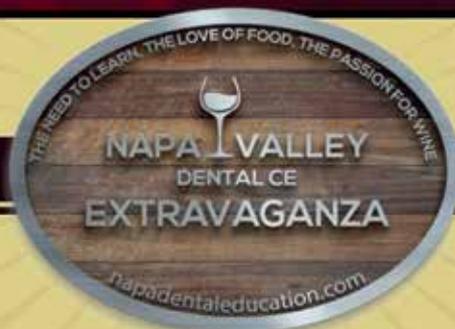
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