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CLINICAL ARTICLE

E-Z Gold: The New Goldent

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SUMMARY

E-Z Gold is a new direct filling gold material that is similar to existing powdered gold formulations but more user-friendly. It is a mixture of pure gold powder and wax (less than 0.01% organic wax), wrapped in gold foil introduced to the dental profession in the late 1980s, and similar metallurgically to gold foil and powdered gold (Goldent) in that, when properly and thoroughly compacted, it has comparable properties: inertness (biocompatibility) and permanence. E-Z Gold's manipulative characteristics are similar to that of a very stiff amalgam, yet more sticky (cohesive) than gold foil, hence the name E-Z Gold.

There is no reported research related to physical properties regarding shear, tensile, and cohesive strength. One can assume that E-Z Gold is similar to old Goldent but with improved softness and working characteristics. Clinical experience in the use of this new restorative direct filling gold material has been encouraging. We anticipate that in the near future, clinical and laboratory research comparing this gold to other types of direct filling golds will be forthcoming.

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INTRODUCTION

Teeth restored with direct filling gold materials offer the most permanent type of restorative modality in dentistry. This degree of permanency is not obtained with other materials. It has a coefficient of thermal expansion similar to dentin (O'Brien, 1989). Generally, direct restorative golds offer superior marginal integrity (Hormati & Chan, 1980; Martin, 1981). The density and hardness of compacted gold enables the restoration to withstand the compressive forces of occlusion adequately. No cementing medium is required, and the surface of condensed gold can be efficiently polished, maintaining the luster and smoothness indefinitely. This creates conditions for optimal gingival response, especially in class 5 restorations, thereby preserving a healthy periodontium.

To obtain optimum physical properties, the direct gold materials are placed into the prepared cavity and are strain hardened by condensers under heavy force. Force is required to weld the gold and to minimize porosities. The gold adapts to tooth structure as it is compacted. During condensation, the strength changes from that of pure gold (BHN 25) to that similar to Type I inlay gold (BHN 75) (Baum, Lund & Phillips, 1985). Tensile strength rises from 19,000 psi to 32,000 psi, while yield strength increases to 30,000 psi. The exact mechanisms are not completely understood (Baum & others, 1985).

Disadvantages include potential fracture of condensed gold under severe shear stresses where stress is not absorbed by surrounding tooth structure.

Ideal density of the restoration should measure 19.3 grams per cubic centimeter; however, this is not achieved in practice. The best achievable density is that of approximately 18.0 grams per cubic centimeter. This difference is due to the presence of porosity and voids (Baum & others, 1985). A comparison of the density with those of silver/mercury alloys indicates that direct gold is inferior. Therefore, since direct gold is not strong enough to resist deformation, it should not be used as a crown or to restore lesions subject to heavy occlusal forces (Baum & others, 1985).

In addition to the inability to achieve maximum density, there are only three minor disadvantages: color, thermal conductivity, and difficulty in manipulation (Coy, 1957). Color can be addressed as an issue of individual or cultural preference. Thermal conductivity has been studied by many in terms of pulpal response. In the study by Thomas, Stanley, and Gilmore (1969), the accepted gold foil procedure was used to reproduce the conditions of clinical practice. Results showed that the condensation of gold foil into sound teeth produced moderate responses initially, with resolution occurring after somewhat longer time intervals. The use of a cement base reduced the response, and those teeth which preoperatively formed irregular dentin showed no adverse response. These findings indicate that the gold foil restoration is biologically sound (Thomas & others, 1969). Another clinical evaluation concluded that it was difficult to isolate malleting as the only factor responsible for the few pulpal problems that occurred without taking into account factors such as damage from cavity preparation, depth of the restoration, irritating bases, or heat from polishing (Balaban & others, 1986).

With its ease of manipulation, E-Z Gold (Ivoclar North America, Amherst, NY 14228) could offer encouragement to those who would like to introduce direct gold into their practice for the first time or reintroduce it to those who gave it up as a result of past experiences. This paper does not intend to present scientific evidence of the superiority or inferiority of this new product. The intent is to inform the reader of the availability of E-Z Gold in an attempt to rekindle use of direct gold in indicated clinical cases and to stimulate research related to its use.

CLASSIFICATION OF DIRECT FILLING GOLD

There are two main categories of direct gold materials: precipitated gold and gold foil (Marzouk, 1985). Precipitated golds are formed by chemical or electrical precipitation to form crystals of pure gold, or by a process of atomization, which produces spherical gold particles. These materials are supplied as powdered gold (e g, Goldent), mat gold, and Electraloy RV (Ivoclar), which is an alloy of gold and calcium (0.1%). Goldent was introduced in the United States in the early 1960s (originally by Morgan, Hastings Co, now by Ivoclar). In 1989 a new granular type of direct gold, Stopfgold (Degussa Corp, Plainfield, NJ 07080), was introduced (Dhiek & Rigelstein, 1989) that morphologically differs from previously available direct filling golds (Elderton & Boyde, 1971). It is similar to Electraloy RV in its properties and handling characteristics (Lambert, 1994) except that it offers an increase in shear strength of 50% when compared to gold foil. The oldest and most durable direct gold is gold foil, which is supplied in four forms: plain foil, corrugated foil, platinum foil, and laminated foil (Marzouk, 1985).

All of the forms of gold listed may be either cohesive or noncohesive. They are noncohesive if surface impurities are present that prevent one increment of gold from cohering to another. The manufacturer supplies books of gold foil in cohesive and noncohesive states. Strips of mat gold, mat foil, and Electraloy RV are essentially cohesive when purchased, but may become contaminated with some impurities during shipment. Because gold attracts gases that render it noncohesive, these gases must be removed from the surface of gold before cold welding. To ensure cohesion, direct filling golds are degassed or decontaminated (Marzouk, 1985) using heat. All direct filling gold products are degassed immediately prior to use except when noncohesive foil is specifically desired (Sturvedant, 1985).

This process of degassing is different for powdered gold (Goldent) and for gold foil. Goldent and E-Z Gold are supplied with a wax coating that must be burned off before compaction. The principles of placing the restoration and the mechanism for cohesion and finishing have not changed with the new developments (Gilmore & Lund, 1973).

INDICATIONS

Because of the nature of cohesive gold, it is advisable not to expose the restoration to excessive stresses such as the shear forces that occur during mastication.

Direct gold should not be used to restore teeth with large pulp chambers and moderate to severe periodontal involvement (Sturdevant, 1985). The smaller the lesion, the more suitable it is for direct gold. E-Z Gold (Figure 1) is recommended for use in small class 1 and class 5 lesions. Patient preference for gold restorations (Figures 2A-2C) will influence the treatment plan for direct gold.

The cast restoration is generally considered to be a stable and reliable option in restorative dentistry; however, it may become defective if caries develops at a margin or if the occlusal surface is perforated

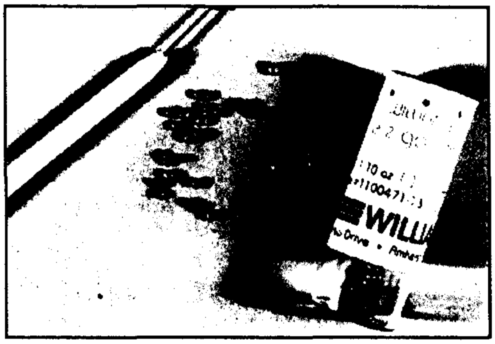

Figure 1. *E-Z Gold*

Figure 2A. *Existing multiple cast restorations with new adjacent occlusal carious lesions*

Figure 2B. *Restored tooth prior to finishing*

Figure 2C. *Finished occlusal restorations*

due to an endodontic access or occlusal wear. When the defect is not extensive, consideration should be given to repair with E-Z Gold (Figures 3A-3C) rather than replacement of the casting. This is particularly true if the restoration is an abutment for an existing fixed or removable prosthesis.

Three factors having the greatest influence on the success of a casting repair are: access to area, ability to obtain adequate isolation, and a choice of restorative material. Research on the interface leakage of direct restorative materials has generally indicated that direct gold restorations offer superior margin adaptation when properly manipulated (Hormati & Chan, 1980). Amalgam is recommended as a second choice (Fitch & others, 1982). Composites are contraindicated because of poor sealing ability (lack of bond between metal and composite) and questionable compatibility with gold alloys.

Clinical Experience

Cavity preparation when using E-Z Gold is similar to one for amalgam (Marzouk, 1985). Condensation,

Figure 3A. *Perforation of existing full cast restoration*

Figure 3B. *Cavity preparation of defective area*

Figure 3C. *Completed restoration*

finishing, and polishing are similar to handling of the old Goldent.

Cavity Preparation

Placement of the rubber dam and complete moisture control is essential (Ingraham & others, 1980).

1. A box-like preparation is required (with sides, ends, and a floor), because E-Z Gold has a tendency to fragment and spread out when initial pressure is applied. Sharp internal line angles are not necessary.
2. Precisely cut line and point angles are not necessary; round internal retention is acceptable, rounded retentive grooves (use #1/2 or #1 round burs sizes) being adequate to retain gold.
3. Margins should be butt joints, although a slight bevel is permissible but without flares (Baum & others, 1985).

Heating Phase

1. Spear a pellet with an annealing instrument (#4) and hold it 1/2"-1" above the flame (Figure 4).
2. The pellet will catch fire, as the waxy matrix burns away. Do not move the pellet away from the flame while the wax is burning.
3. After the wax substrate has burned off, keep the pellet in the flame for 2-3 more seconds until it glows with a dull red color.
4. Remove from flame. Wait a moment for the pellet to cool, then place it in the cavity.

The pellet will tend to "sputter" while it's burning.

Avoid too much heat (white-hot color), as this will melt the gold powder. The pellet will shrink and become very hard and unmanageable.

An underheated pellet will have a waxy consistency because of the remaining organic matrix.

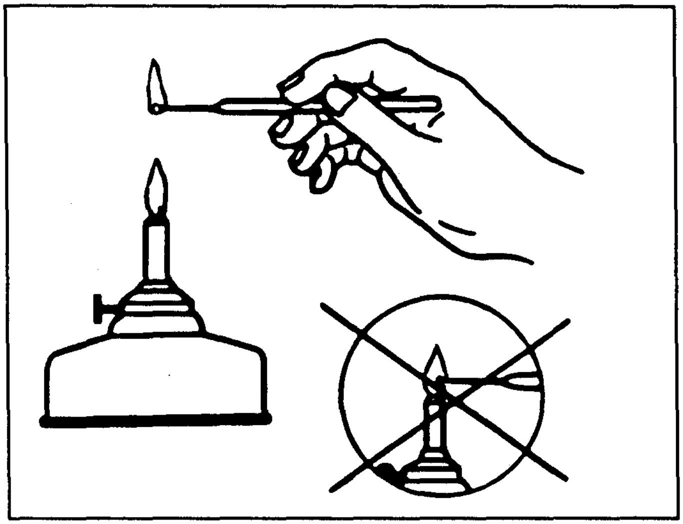

Figure 4. *Annealing E-Z Gold*

Condensation Phase

1. Transfer the annealed pellet to the cavity preparation. An amalgam condenser is used to press the pellet into the bottom half of the cavity preparation (Figure 5). If the cavity is larger than the available pellets, two or three pellets are placed simultaneously. Do not condense until the pellet(s) has been tamped into position.
2. Using the small condenser (hand instruments: E-Z Gold condensers #1 and #2, Thompson Dental Mfg, Missoula, MT 59801 or serrated amalgam condenser), condense pellets into retentive areas. The condenser is stepped over the entire mass of gold so that each condensed site overlaps the previously condensed site (Figure 5). If the gold tends to rock within the cavity, the initial pellet was too small. Try again with a larger pellet. When at least half of the preparation has been filled with the material, the remainder of the gold can then be condensed either with hand instruments or an Electromallet (McShirley Products, Inc, Valencia, CA 91355) set at a low frequency and moderate intensity.
3. Continue the build-up by adding one pellet at

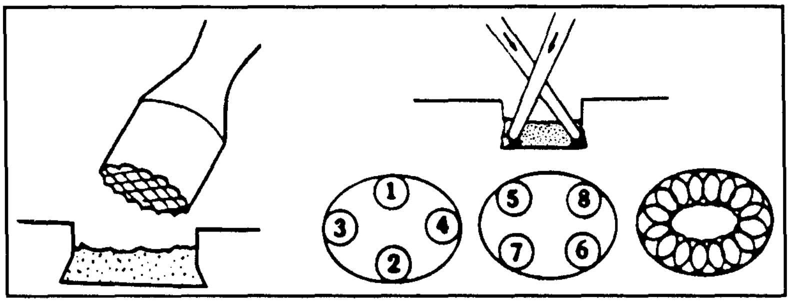

Figure 5. *E-Z Gold condensation (steps 1 - 4)*

a time; condense each thoroughly before adding the next one. Successive pellets are placed and condensed so that the walls are banked and the restoration is concave.

Before adding additional pellets, probe the surface vigorously with a stiff explorer to be sure all the air (porosity) has been eliminated and that adequate retention has been achieved. If the explorer sinks or penetrates into the gold, use the condenser again with more force and pressure. If it does not leave a hole, the gold is well condensed. Continue until the cavity is slightly overfilled to allow for proper finish. The final surface is condensed with a foot condenser using high frequency and moderate intensity to create a dense, even surface.

Finishing and Polishing

1. Burnish the restoration using a #4 nondirectional E-Z Gold file (Thompson Dental Mfg) or an amalgam burnisher.
2. Apply a revolving white stone or finishing bur to finish the surface as one would an amalgam.
3. After removing excess, establish proper contour.
4. Burnish the surface with a discoid or ball burnisher to strain harden the surface.
5. Final polish is accomplished with Sof-Lex disks (3M Dental Products, St Paul, MN 55144), pumice, and amalgloss.

Final polish is often optional.

DISCUSSION

With advancement of technology and introduction of new materials to the practice of dentistry, general dentists should incorporate improved restorative services for their patients. Although some patients may not accept the proposed treatment, it is the dentist's responsibility to recommend the best possible treatment based upon the needs of the tooth and permanency and longevity of the restoration recommended (Mjör & Medina, 1993).

As we move into the twenty-first century, with an increase in life expectancy, there will be an increase in the senior citizen population. It is expected that these patients will demand and expect a high level of dental services along with a higher level of quality of life (Medina, 1987). Direct filling gold restorations have proven over time to offer superior quality in terms of permanency and biocompatibility. With E-Z Gold available, the dental practitioner can deliver an excellent restoration with relative ease and possibly at a lower cost. General armamentarium available in the dental office can be utilized in tooth preparation, material condensation, finishing, and polishing of E-Z Gold. This is encouraging, since with continued de-emphasis on teaching of direct filling gold in dental schools (Lambert, 1980, 1990; Nuckles, 1989), it's becoming more difficult to purchase mechanical condensers (McShirley Electromallet) and other gold foil instruments.

CONCLUSION

Although direct filling gold is no longer the dentist's first choice for most restorations, it still has a place in today's ever-growing selection of restorative materials. Knowing how and when to use direct filling golds can be an invaluable service to patients and subsequently a significant practice builder. With the development of E-Z Gold by Lloyd Baum in the late 1980s, direct filling gold restorations have become easier to place.

This improved manageability has made the restoration placement less time-consuming and more predictable. Its use, however, should be limited to small lesions for optimum success. Clinical experience, as with other forms of gold, will dictate use in larger lesions.

By incorporating direct filling gold into a practice, dentists can offer their patients a restoration with greater expected longevity and better tissue response than either amalgam or composite and provide optimum restorative care.

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