

# What is the Ideal Direct Posterior Restoration?

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Direct restorations have been placed in teeth for more than a century. During that time, dental caries has been claimed to be cured multiple times and/or definitively treated with numerous ideal direct restorations. However, caries still remains to be the most prevalent disease to affect mankind. Today, manufacturers, “key opinion leaders,” researchers, academics, sales representatives and many experienced and inexperienced clinicians alike repeat similar claims as in the past. The word “ideal” and “gold standard” are used audaciously and casually in ads, lectures and conversations to justify or explain why a dentist should buy another “new and improved” product. Does the ideal direct posterior restoration even exist?

At one point, gold alloy and pure gold were considered to be the ideal indirect *and* direct posterior restorations (Fig. 1). In contrast, only a small percentage of the restorations currently placed use these materials. Ironically, gold alloy and pure gold restorations are often found to be the oldest and least carious in the oral cavity. Currently, many dentists choose gold alloy as the primary option for their own mouths, but are reluctant to offer it to their patients. As tooth-colored direct resin-based composite restorations and all-ceramic indirect restorations have become popular with the lay public, clinicians rarely offer gold restorations as an option to patients. The simple fact that tooth-colored restorations offer better aesthetic results seems to imply

that they are superior in other aspects such as strength, wear and longevity. This misconception has led to abuse of the currently available aesthetic materials, cessation of proven techniques and safeguards and general ignorance of the shortcomings of the new and reportedly improved direct posterior restorations.

The purpose of this article is to examine the two most popular types of direct posterior restorations – amalgam and resin-



*Fig. 1: Gold inlay and gold foil restorations. Is gold still the “gold standard”?*  
Photo courtesy of Dr. Allan Rappold.

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based composite – and provide direction on how they are best used within current limitations. For those who believe that amalgam or resin-based composite is the ideal direct posterior restoration, this article might provoke thought and reconsideration of product and technique selection.

### Ideal Characteristics of Direct Posterior Restorations

Presently, *none* of the available direct posterior restorations possess all of the ideal characteristics listed below. It is interesting to note the anxiety and controversy this statement involves, to infer that the most common procedure provided by dentists does not provide the optimal properties for restoration of teeth. Many clinicians have been taught or misled to believe that whatever they have placed in a patient's mouth is the ideal restoration because it is the newest, most popular or touted by an expert. The following list represents most of the ideal *desired* characteristics of direct posterior restorations. Compare your current choice of direct restorative material with the following list and see how many of the characteristics are actually present in your clinical procedures.

- **Adhesive system:** contained within the material or separate (if simple and quick) while maintaining its strength continuously over the lifetime of the restoration
- **Bacteriostatic:** over the lifetime of the restoration
- **Biocompatible:** non-allergenic among all people
- **Color:** tooth-colored, with color stability over time
- **Cost:** low for all patient use
- **Aesthetics:** simple shade systems that duplicate optical properties of teeth; no color change over time and withstands staining
- **Handling:** simple, bulk placement, non-sticky, stays where placed and easy to finish/polish
- **Innovation:** improve concept, such as color change that alerts clinicians to defects or recurrent caries
- **Longevity:** proven over time with no defects; clinically predictable
- **Non-technique-sensitive:** works the same in every clinicians' hands, regardless of situation
- **Post-operative sensitivity:** non-existent regardless of situation
- **Preventive chemistry:** releases chemicals/ions that promote remineralization continuously at a level that is clinically significant
- **Properties of tooth structure:** mimics enamel and dentin and resists breakdown and bacterial assault
- **Radiopaque:** easily identifiable on radiographs
- **Setting and working time:** fast snap-set and long working time (minutes if necessary)
- **Smoothness:** similar to natural tooth structure, retains smoothness over time and does not appear dull with wear
- **Strength:** able to withstand occlusal forces

- **Wear, shrinkage and stress:** similar to natural tooth structure and low to non-existent

Upon reading the above list, many will agree that there is no direct posterior restoration that currently possesses all of these characteristics. However, a few manufacturers continue to claim that their product or technique possesses *all* the ideal characteristics. Be cautious with claims that seem too good to be true. This list is meant to encourage the following:

**Manufacturers** to develop a direct restorative material that meets *most* of the above characteristics with the long-term goal to provide *all* of the characteristics; ensure that marketing claims are ethical, truthful and can be proven with both clinical and in-vitro research.

**Clinicians** to provide proper informed consent to patients with all options for direct restoratives, their benefits and limitations and average longevity in the oral cavity; recognize current limitations with direct restoratives and to do your best to compensate for the limitations with improved skill and proper technique.

**Patients** to better understand the materials that are placed in their teeth and to be informed of their choices.

### Amalgam as a Direct Posterior Restoration

Amalgam continues to be either loved or hated in all areas of the world with many dental offices refusing to offer this type of direct restorative. Tooth-colored resin-based composite is now believed by many clinicians to be highly superior to amalgam. Some clinicians make their income by removing non-carious, unaesthetic, clinically acceptable amalgam restorations and promoting the still-controversial allegations of mercury toxicity. This practice of encouraging patients to remove sound amalgam restorations by preying on public and patient anxiety for profit is unethical and highly questionable of a "professional." Despite their unaesthetic shortcomings, amalgam restorations are still supported by the ADA, WHO, FDI and the FDA and are an acceptable and viable treatment option for direct posterior restorations.

Observation of patients you or another dentist have treated will reveal the following about amalgam restorations:

1. Many amalgams serve for several decades (Fig. 2).



Fig. 2: Well-placed and non-carious amalgam restorations at 25 years.

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2. It is common to experience fractured cusps, due to preparation technique of undercuts and the wedging effect of amalgam (Figs. 3 & 4).
3. Most amalgam restorations cause staining of dentin and residual caries (due to the bacteriostatic properties of silver) (Figs. 5 & 6).
4. Large amalgam restorations that involve most of the tooth with no other option but an onlay or crown still function relatively well (preferable an onlay when at all possible) (Fig. 7).
5. Old amalgam restorations that have discolored and stained the tooth, but with little evidence of recurrent caries (clinically or radiographically) (Figs. 8 & 9); these restorations should be carefully examined over time and potentially replaced when necessary.

The main advantages of amalgam as clearly demonstrated and proven over many years of successful use are: bacteriostatic, easy to place and shape, durable, strong, have longevity and low cost. The main disadvantages are: unaesthetic properties, staining of tooth structure and propensity for fractured cusps due to preparation technique (excessive tooth removal for retention) and expansion/contraction characteristics dissimilar to tooth structure. In searching for the *ideal* direct posterior restorative, it is evident that amalgam has many of the ideal characteristics, namely bacteriostatic, longevity and strength. Amalgam is often reserved for patients who are limited in financial resources, have high caries risk or have minimal third-party benefits. Ironically, it is these patients who might benefit most from amalgam's bacteriostatic and longevity properties, while the patients with more adequate insurance and financial resources receive aesthetic but non-cariostatic materials.

When deciding about your continued use of amalgam, carefully consider each characteristic. If you must choose to use amalgam for a highly visible first pre-molar, discuss with your patient the benefits and limitations of all of the restorative options. When considering the potential graying of tooth structure if amalgam is used, against its proven longevity and known bacteriostatic properties, you might decide resin-based composite is the best option. However, when treating a maxillary second molar that is not visible when smiling, you might recommend an amalgam restoration. It is equally important to consider each patient's caries risk potential and estimated needed longevity in his or her oral cavity based upon their habits, history and health.

### Resin-based Composite as a Direct Posterior Restoration

Resin-based composite (RBC) has been continuously improved over the years and manufacturers are striving to meet the ideal characteristics listed above. However, two of the most important characteristics have not been adequately met, bacteriostatic properties and increased longevity. It is known through both research and observation that posterior direct resin-based composite restorations



*Fig. 3: Fractured DB and DL cusps of a mandibular molar with staining and minor caries; an onlay or crown would be the optimal restoration.*

*Fig. 4: Fractured facial cusp of maxillary premolar with staining and minor caries; an onlay would be the optimal restoration.*

*Fig. 5: Fractured maxillary MB cusp with an older mesio-occlusal amalgam restoration; note the long-lasting gold inlay now forgotten but rarely taught. Photo courtesy of Dr. Sameer Puri*

*Fig. 6: Removal of amalgam restoration demonstrates minor caries and staining; a CEREC-fabricated onlay was the final restoration chosen. Photo courtesy of Dr. Sameer Puri*

*Fig. 7: Twenty-year-old fractured and patched amalgam restorations, recurrent caries and fractured cusps that require onlay or crown placement.*

*Fig. 8: Questionable amalgam restorations more than 25 years in service; is it best to leave them alone?*

*Fig. 9: Completed resin-based composite restorations demonstrating lack of severe caries; will these new restorations last 25 years?*

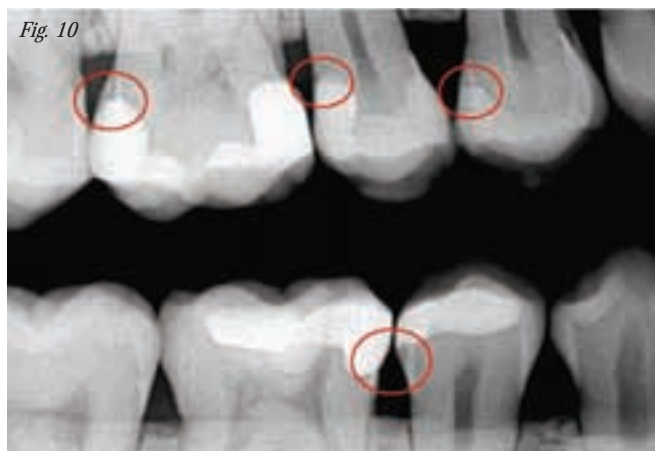
do not possess the same longevity and bacteriostatic properties as amalgam (Fig. 10). Yet, they can be highly aesthetic and have revolutionized the aesthetic/cosmetic desires of dentistry. In which clinical situations are the aesthetic characteristics of a material more important than the other properties?

The emphasis of resin-based composite material by both manufacturers and key opinion leaders as a solution for most restorative dental needs is unfortunate. The resultant overuse of RBC is at the expense of patients. Adequate informed consent is required, including candor regarding its longevity in comparison to other restorative materials. Many third-party benefit providers in the U.S. will reimburse a portion of the allowable amount after only five years. Despite this, each time a restoration is replaced more tooth structure is removed with a decrease in strength and an increase in microbiological assault. As a result, many of the “first composite replacements” become crowns instead of onlays or another resin-based composite restoration.

Observation of patients you or another dentist has treated will reveal the following about resin-based composite restorations:

1. Highly aesthetic for both anterior and posterior restorations (Fig. 11)
2. Susceptible to recurrent caries, even under sealants (Fig. 12). Dr. Rella Christensen has demonstrated through clinical research that more than 90 percent of sealants have active caries at 10 years when the sealants are removed. (TRAC Research)
3. Staining of the margins often becomes evident after a short period of time
4. If carious, the lesions tend to be more severe (in comparison to amalgam)
5. Moderate to high recurrent caries rate interproximally
6. Tend to chip and some might stain bodily over time
7. Might last several years in a patient with low caries risk, good oral hygiene and excellent technique in placement; however, in a patient with moderate-to-high caries risk, longevity can be markedly less

Despite the limitations mentioned above, including high cost, technique sensitivity of the product, high overhead for time spent, poor reimbursement rate and an always-changing choice of materials claiming to be superior to the previous versions; resin-based composite restorations for direct posterior use are improving. Manufacturers are making sincere efforts to solve some of the challenges that have continued to plague these restorations for decades. New “universal” adhesives that can be used with or without phosphoric acid etching for direct and indirect restorations are being introduced to simplify the race to be the next superior “generation.” Flowable resin-based composites, which have been one of the most abused dental materials, are being changed to include stress-reducing properties at a



*Fig. 10: Is it radiolucent flowable resin-composite or recurrent caries after only four years in service? All restorations exhibited recurrent caries with two direct pulp caps in this 32-year-old moderate-carries risk patient.*

*Fig. 11: How long will these well-placed, large resin-based composite restorations last before recurrent caries is detectable?*

*Fig. 12: Recurrent caries was evident under both restorations (first molar example of failed sealant).*



*Fig. 11*



*Fig. 12*

lower shrinkage rate. Some companies have redesigned their flowables in response to practitioners placing it in increments that are larger than original recommendations of less than 0.5mm. The new flowables compensate for practitioner abuse by decreasing stress and shrinkage at a larger placement depth. Bulk fill or “dentin replacement materials” are being introduced that actually meet manufacturers’ claims. Adhesives are being combined with resin-based composite to simplify procedures. Many of these new introductions are major steps in the right direction (as middle stage products) but presently manufacturers have not truly addressed the issues concerning bacteriostatic properties, longevity and lifetime maintenance of dentin bond strength over time. If these three limitations were presently met by any system, we would not observe the higher caries rates among this class of restoration.

### Compensation for Limitations Through Improved Technique

It appears that resin-based composites will continue to dominate and replace amalgam, despite their limitations. Another factor contributing to the decline of amalgam is worldwide political pressure to discontinue its use. Until ideal solutions can be addressed with the composite itself and the adhesive systems

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manufactured for them, it is the responsibility of clinicians to perfect their techniques in placing restorations to improve longevity and decrease recurrent caries. The following are suggestions to improve outcomes of direct posterior resin-based composite restorations:

- **Rubber dam isolation:** still the gold standard in reducing contamination from blood, saliva and other contaminants (Fig. 13).
- **Conservative preparation:** extension for prevention is no longer the accepted treatment standard, nor is the preparation technique for amalgam the same as for resin-based composite.
- **Disinfection:** TRAC Research (Dr. Rella Christensen) has demonstrated that two one-minute coats of a 5% Glutaraldehyde/35% HEMA product (i.e. Gluma by Heraeus Kulzer, MicroPrime by Danville, etc.) disinfect tooth preparations and eliminate bacterial contamination.
- **Adhesive:** use a well-proven adhesive that maintains consistent bond strength under varying conditions. CR research has demonstrated in pilot studies and unpublished research that procedures as simple as varying the amount of air pressure and time thinning an adhesive can change bond strengths from 2MPa to 50MPa.
- **Flowable:** use of a resin-based flowable composite in the box of a preparation, based on the claim it adapts better to walls, is not a reason to use this high-stress, high-shrinking product. If flowable is used, use it at 0.5mm increments, or use a product that has research to prove it can be placed in thicker increments with decreased stress (i.e. SureFil SDR by Dentsply Caulk).
- **Glass ionomer products:** use of a resin-modified glass ionomer as a liner or base is recommended for its preventive chemistry, decreased sensitivity and insulating properties.
- **Placement of composite:** place the material in minimal depth increments (usually 2mm or less) while being careful to avoid pull-back or introduction of voids. Some newer bulk-filling composites allow for placement up to 4-5mm, while maintaining low shrinkage and stress.



*Fig. 13: Rubber dam isolation is still the gold standard!*

*Fig. 14: Properly contoured, finished and polished resin-based composites on mandibular premolars. Note the existence of occlusal embrasures and marginal ridges on the premolars, unlike the second molar.*

- **Finishing and polishing:** take time to carefully finish restorations, providing adequate marginal ridges, simple occlusal anatomy, avoiding sharp angles (that usually chip within one year), avoiding heavy occlusal contacts and overfinishing of the margins (which creates gaps and another area for micro-leakage and bacterial assault) (Fig. 14).
- **Follow-up:** monitor the restorations and check them radiographically and clinically on a routine basis. Examine the restorations for excessive wear, chips, open margins, staining and caries. If you have to repair, do it sooner rather than later.

## Conclusion

Both amalgam and resin-based composite for direct posterior restorations have advantages and limitations. However, neither material has all the ideal characteristics. Providing patients with adequate informed consent for choice of treatment, materials, benefits, risks and limitations is not only ethical, but realistic as to how these new advanced materials hold-up over time. Exciting new products will continue to inundate the profession with claims of being superior. We advise caution. Providing patients with resin-based composites is not a high-revenue procedure for most dentists, yet it is imperative that we improve our techniques to compensate for the limitations of the products until the ideal direct restorative material is introduced. ■

## Author Bios

**Dr. Paul Child** is the CEO of CR Foundation, a nonprofit educational and research institute (formerly CRA). He conducts extensive research in all areas of dentistry and directs the publication of the *Gordon J. Christensen Clinicians Report*, and their other publications. Dr. Child is a prosthodontist, a certified dental technician and maintains a private practice at the CR Dental Health Clinic in Provo, Utah. Dr. Child lectures nationally and co-presents the "Dentistry Update" course with Drs. Gordon and Rella Christensen. He lectures on all areas of dentistry, with an emphasis on new and emerging technologies. He maintains membership in many professional associations and academies. Further information is available at [www.cliniciansreport.org](http://www.cliniciansreport.org).



**Dr. Gordon J. Christensen** is founder and director of Practical Clinical Courses (PCC) in Utah. This group is an international continuing education organization providing courses and videos for all dental professionals. He is also co-founder of the nonprofit *Gordon J. Christensen Clinicians Report* (previously CRA), as well as an adjunct professor for Brigham Young University and University of Utah. He is a diplomate with the American Board of Prosthodontics. Dr. Christensen has presented more than 45,000 hours of continuing education throughout the world and has published many articles and books. Further information is available at [www.pccdental.com](http://www.pccdental.com).

