

# Predictability and Aesthetics With Nonmetal Onlays



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Nonmetal onlays are slowly becoming more popular due to 2 main reasons. First, clinicians and their patients expect more natural-looking restorations, and second, patients are becoming more aware of the benefits of tooth conservation. For example, in recent years patients have become more aware of dental implants, and now many view preparing or “cutting” healthy teeth for a fixed bridge as almost unthinkable. The combination of tooth preservation and excellent aesthetics makes porcelain onlays a good alternative to PFM crowns.

The author (Dr. Ruiz) has performed thousands of nonmetal onlays with outstanding results. In his experience, the long-term benefits to the patient surpass those of PFM crowns, and nonmetal onlays have completely replaced the use of PFM crowns in his private practice. Educating patients about the benefits, consequences, options, and longevity of different restorations is mandatory. Achieving excellent aesthetics and blending of the restoration to the tooth can be challenging if a tooth-conserving preparation is used.

This article, including a clinical report, presents a technique to achieve excellent aesthetic results, while using a tooth-preserving preparation without axial reduction. This is possible by predictably achieving a good contact lens effect, using a very practical hybrid technique combining pressable and layered ceramics with a synthetic porcelain (HeraCeram, now VenusCeram [Heraeus Kulzer]). A simple and predictable technique for cementation using a self-etch bonding system will also be presented.

## NONMETAL ONLAYS

It could be argued that porcelain onlays are today's ideal indirect restorations.<sup>1</sup>

Porcelain onlays are excellent alternatives to PFM crowns, with very good clinical results.<sup>2</sup> Although porcelain onlays are usually more aesthetic than PFM crowns, excellent aesthetics can be challenging when the cavo-margins are left in a visible area (Figure 1). For this reason many clinicians routinely perform axial reduction for aesthetic purposes (Figure 2), thus covering the entire facial surface of the tooth with the porcelain and in fact turning the onlay into a 3/4 crown or onlay-veneer type of restoration. This facial axial reduction takes away part of the main benefit of partial coverage onlays, which is tooth conservation. It also compromises the restoration's longevity by adding shear forces to the

restoration; all restorative materials fare better under compressive forces, and axial reduction may increase the chances of porcelain fractures because it adds shear forces.

Mechanically, a more ideal preparation would have the required 2-mm occlusal reduction of the buccal cusp, and would leave a butt cavo-margin approximately between the point where the incisal and middle thirds of the tooth meet, on the buccal surface (Figure 3). This margin placement allows maximum tooth preservation and permits mostly compressive forces to be present. In order to use this more tooth conserving and mechanically ideal preparation, it would require predictably achieving a contact lens effect to blend the restoration with the remaining tooth. This is impossible if we use traditional pressable porcelain or CAD/CAM restorations, as they are made out of a one shade, one opacity ingot or block, respectively.

Another option would be to use a fully layered porcelain onlay, which is a very difficult and time-consuming laboratory procedure requiring the fabrication of a refractory die. A new option presented in this article is to use a combination of pressable and layered porcelain using HeraCeram, a synthetic ceramic system with excellent optical characteristics. Using this technique, a blending and contact lens effect can be achieved. This new technique has the additional advantage of having a simpler and predictable laboratory procedure, making it more cost-effective for the laboratory and dentist.

## CLINICAL REPORT

### Informed Consent

A male patient in his 30s presented with a large silver filling approximately 15 years old and with secondary caries on tooth No. 30 (Figure 4). He insisted he wanted a tooth-colored restoration, and he was presented with the option of a PFM crown or a more tooth-conserving metal-free onlay. After showing the patient the difference in tooth structure removal required for each restoration (Figure 5), he reported having had a similar situation a couple of years before, which was treated with a PFM crown (Figure 6). He was not satisfied with the amount of tooth he felt had been “drilled” or with the less-than-ideal aesthetic results, and for this reason he chose the porcelain onlay.

The patient was informed that porcelain



Figure 1. Onlay with margin on the mid facial of the tooth; it shows a monotone opaque restoration with poor margin blending. Commonly seen with pressed ceramics or CAD/CAM.

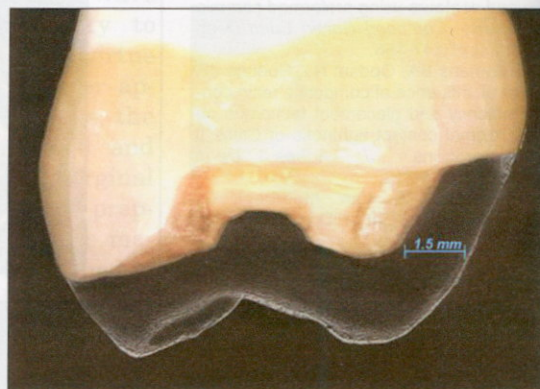


Figure 2. Onlay preparation with axial reduction. This is commonly done to overcome the poor blending of the restoration.

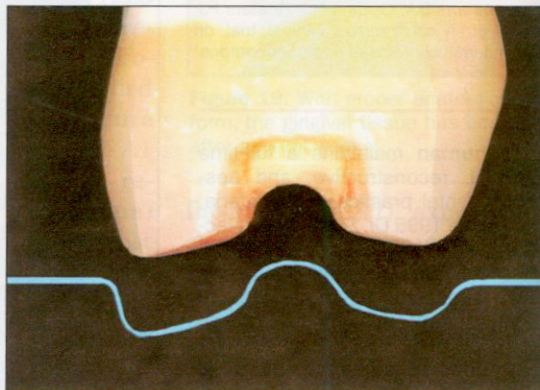


Figure 3. Ideal preparation, with a 2-mm occlusal reduction, leaving the cavo-margin approximately between the incisal and middle thirds of the tooth.

onlays are newer restorations with a shorter track record than PFM crowns, and that the restoration may not last as long as a PFM crown, although the literature shows that they are holding up very well.<sup>3-6</sup> Nevertheless,

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**Figure 4.** Large silver restoration with secondary caries on tooth No. 30.



**Figure 5.** Illustration used by the author to educate patients on the differences in tooth structure reduction required for a PFM crown and a nonmetal onlay.



**Figure 6.** Observe secondary caries and also a large amount of healthy enamel on the buccal surface; also observe PFM crown on tooth No. 31.



**Figure 7.** After removal of amalgam.

after considering the benefits of less tooth reduction, less gingival irritation, and possibly less chance of future endodontic therapy because of less tooth "drilling," he chose

the porcelain onlay.

Partial coverage onlay restorations require less tooth removal, are more biocompatible than the commonly used PFM crowns, and if done properly can fulfill our patients' demand for a natural-looking restoration.<sup>7</sup> Although gold onlays have the best longevity of all indirect restorations<sup>8-10</sup> and have similar tooth-preserving benefits as nonmetal onlays, they are mostly in disuse because patients do not want to have gold visible in their mouths. The PFM crowns are the most popular indirect restorations, although they have negative side effects.<sup>11</sup> The tooth preparation required for a PFM crown is very invasive to the tooth. A study by Edelhoff and Sorensen found that 67.5% to 75.6% of the tooth structure is removed during a full crown preparation,<sup>12</sup> often healthy tooth structure is removed to achieve the needed form for mechanical retention. PFM crowns also require aggressive soft-tissue manipulation, including cord packing, to place the margins subgingivally and thus hide their unsightly margins; this often leads to chronic gingival inflammation.<sup>13-15</sup> As responsible dental clinicians, our goals should be to educate our patients regarding the different restorative choices and their benefits, options, negative consequences, and longevity. Tooth preservation and the protection of the overall health of the supporting oral tissues is a must.<sup>16,17</sup>

#### Tooth Preparation Technique

The preparation for a non-metal adhesive onlay is less complicated than the traditional gold onlay preparation. Gold onlay preparation requires exacting geometrical design, retention grooves, offsets, and exact taper to provide the necessary mechanical retention. Tooth preparation for nonmetal onlays is more simple, as long as some basic principles are followed.

After careful removal of the old amalgam restoration (Figure 7), the caries was carefully removed. Attention was given to avoiding the excessive removal of enamel, as a good enamel margin will yield more predictable results (Figure 8). Areas in dentin

considered to be close to the pulp, or very deep, may be lined with a very thin layer of resin-modified glass ionomer (Vitrebond [3M ESPE])<sup>18,19</sup> to decrease postoperative sensitivity. Subsequently, the minimum 2 mm of occlusal reduction was performed, avoiding sharp line angles. In areas of high aesthetic demands, a deep rounding or bevel of the cavo-margin allows for better blending of the color of the tooth (Figure 9). An additional aesthetic margin design could be a reversed chamfer, as advocated by Dietschi and Spreafico<sup>20</sup> (Figure 10).

Cord retraction is usually minimal or unnecessary, as most cavo-margins are supra-gingival. For the same reason, impressions can easily be made with any VPS impression material.

#### Laboratory Technique

Some of the advantages of pressed porcelain are excellent marginal adaptation and no need for a refractory die. Pressable ceramic has slightly better mechanical properties than layered ceramic, and it is considerably more technique friendly. The disadvantage is that the pressing can only be done with one ingot of a given opacity and shade, making the restoration monotone with little chance of a marginal blend. Many technicians use superficial stains to improve the aesthetics of the pressed ceramic restorations; this improves the color match but it does not improve marginal blending or provide a contact lens effect. Additionally, staining is, in general, a temporary solution because when the restoration is adjusted or polished the stain will be removed, and superficial stain will naturally disappear after a few years of wear, brushing, and acidic drinks.

By using a hybrid technique, similar to the cut-back technique used with anterior pressed veneer restorations, high aesthetics and a contact lens effect can be achieved, while still having all advantages of the pressable material and technique. The author uses a translucent synthetic ceramic system with very unique optical characteristics<sup>21</sup> (HeraCeram). This material has compatible pressable and layered

ceramic, which has proven to be beneficial in achieving optimal aesthetics.

After model work was complete, a full contour wax-up was fabricated (Figures 11 and 12). The wax-up was cut back in specific areas to allow space for the layered ceramic, which would be added later (Figures 13 and 14). Cutting back the porcelain after the full contour wax-up is pressed would be an alternative. No area of the wax-up should be thinner than 1.2 mm, as this could compromise the strength of the onlay. After spruing and investing (Figure 15), a highly translucent ingot (TS1 or TS2 from HeraCeram) was used as a pressable base. This exceptionally translucent material blends well with the tooth and helps achieve the so-called contact lens effect on the margin.

On top of this translucent pressed material the selected areas were covered with a 0.8-mm layer of HeraCeram body porcelain of the correct shade, giving the restoration higher value and opacity where needed and improved color match (Figures 16 and 17). Some intrinsic stain can be added at the same time. By using layered porcelain over a pressed base, a single firing can be done to achieve excellent aesthetic results (Figure 18).

#### Cementation Technique

During the bonded cementation procedure, attention to detail is necessary. At the cementation appointment, the tooth was properly cleansed with pumice on a rubber cup. In addition, the use of a sandblaster or micro-abrader is desirable to clean the internal areas of the preparation, especially if composite has been used to build up the tooth.

Nonmetal onlays must be cemented using resin cement and adhesive systems.

Barghi and other authors have reported serious postoperative sensitivity using a total-etch cementation technique.<sup>22,23</sup> A self-etch bonding system was used to minimize this problem. Self-etch bonding systems are less technique complicated and more clinically forgiving in regard to humidity, as shown by Finger and Tani.<sup>24</sup> Because of its very thin film layer, iBond (Heraeus Kulzer) was used



**Figure 8.** After removal of caries, carefully preserving valuable enamel.



**Figure 9.** A deep rounding of the buccal cavo-margins is done to allow for a better transition and blend between the tooth and the restoration.



**Figure 10.** An alternative aesthetic margin design is the reverse chamfer.



**Figures 11 and 12.** Full-contour wax-up.



**Figures 13 and 14.** Observe the areas of wax cut-back.



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Figure 15. Spruing of the wax-up.



Figures 16 and 17. Adding layered feldspathic HeraCeram of the desired shade to improve opacity and value.

successfully in combination with a clear, dual-cure resin cement (RelyX ARC [3M ESPE]).

Self-etch bonding systems do not etch enamel as well as

traditional phosphoric acid, and it is desirable to etch the margins for 15 seconds with 37% phosphoric acid. Limiting etching to enamel is important, as it will decrease the chances of postoperative sensitivity. Three generous coats of iBond were applied to the tooth. Because self-etch bonding systems need time to do their job of penetrating the smear layer and dentin to etch and prime, it was necessary to wait 30 seconds. A mild stream of air was then applied to the surface for a minimum of 5 seconds to remove the solvent, leaving a very thin film; the bond should not show any movement after proper solvent removal. The use of this very thin bonding system permits light-curing without the concern of the bond film thickness interfering with the full seating of the restoration; light-cure for 10 seconds.

The cavity was then filled with clear RelyX ARC, the restoration seated fully, and the excess cement removed. After tacking the restoration in place with a 5-second light

cure, the now semi-firm cement was easily removed with a No. 12 Bard-Parker blade.

After detailed cleanup was completed, the restoration was covered with a water-based petroleum jelly, and a full light-cure was performed. This step will eliminate the oxygen-inhibited layer, thus minimizing the common ditching of the margins. After final curing, the occlusion was checked and adjusted, and final polish was done using Dialite (Brasseler) diamond-impregnated rubber cups polishing system (Figure 19).

The patient was recalled 2 weeks later and reported no postoperative pain; he was very satisfied with the results.

### CONCLUSIONS

The author has performed thousands of nonmetal porcelain and composite onlays with outstanding results. Patients should be educated regarding the advantages of this restoration, as well as its limitations. Better aesthetic results can be achieved with the use of a hybrid restoration using pressable and lay-

ered porcelain. Using a restoration that can achieve a good blend or contact lens effect allows us to perform a simpler, more tooth-conserving, and more mechanically sound preparation. Additionally, the technique described, using a self-etch bonding system, will decrease the occurrence of postoperative sensitivity and simplify the bonded cementation technique. ♦

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Figure 18. Final restoration.



Figure 19. Final restoration immediately after bonded cementation.

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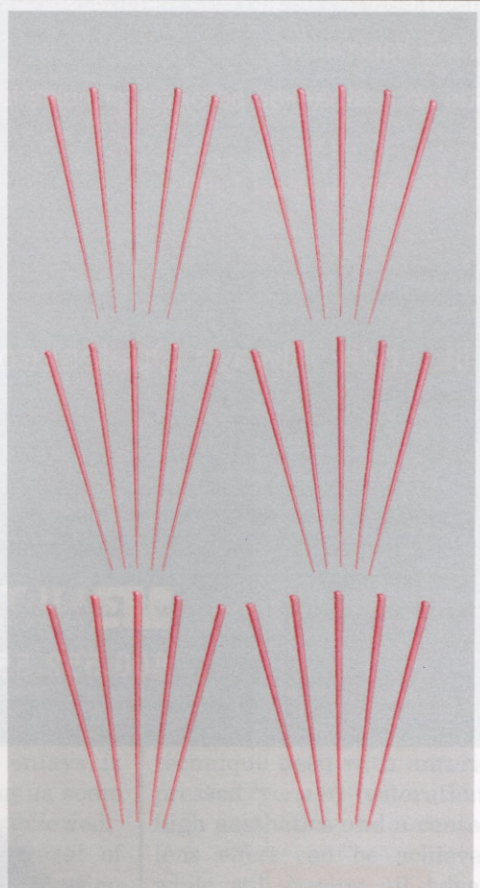
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