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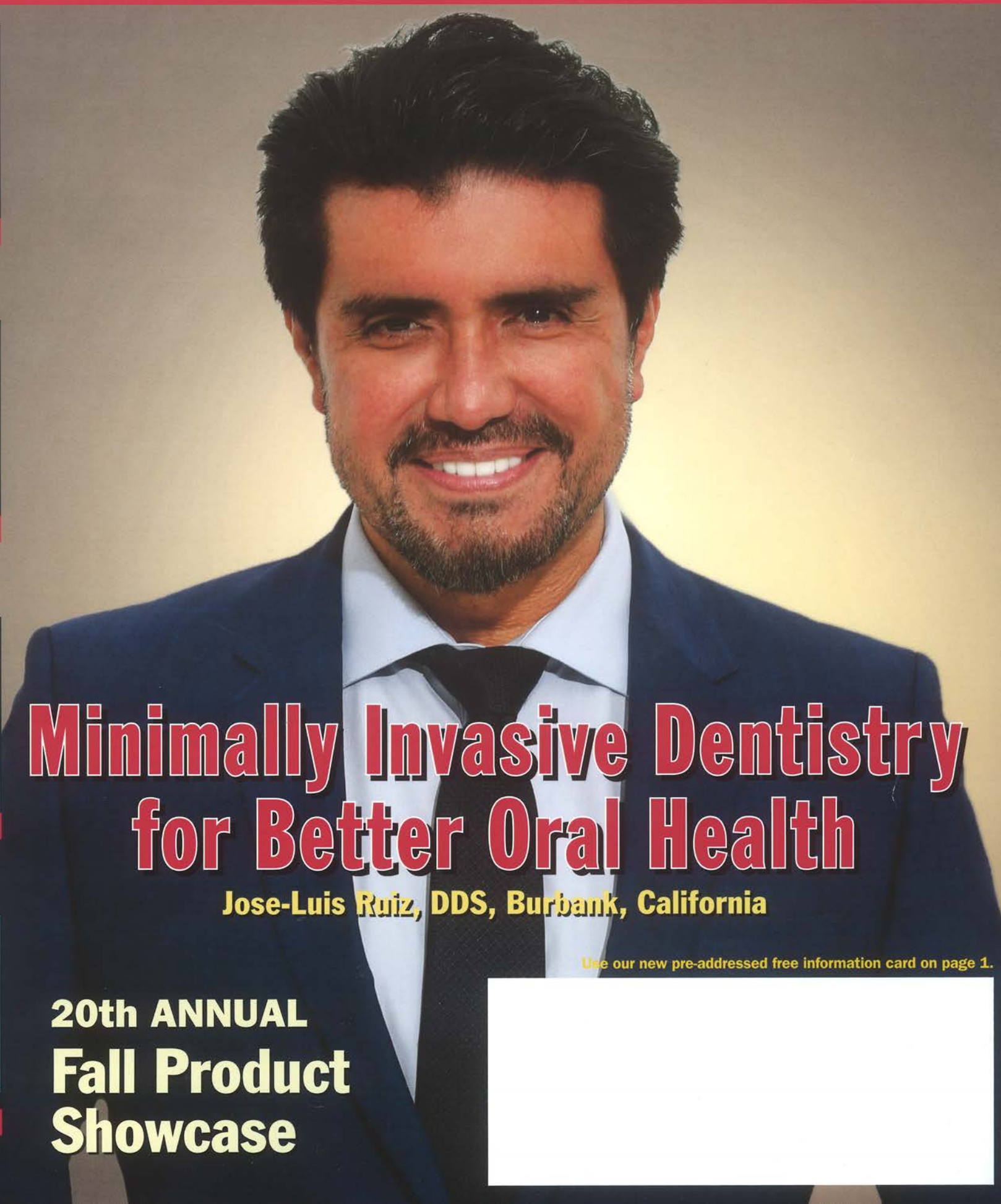

Minimally Invasive Dentistry for Better Oral Health

Jose-Luis Ruiz, DDS, Burbank, California

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Avoiding Subgingival Margins for Healthier Dentistry

Using a Supragingival Preparation Protocol

Jose-Luis Ruiz, DDS

INTRODUCTION

The worst-kept secret to healthier and more predictable restorative dentistry is keeping margins supragingival, whenever possible. Subgingival margins are often unhealthy, causing permanently inflamed gingiva and permanent periodontal damage associated to bad restorative margins, as well as red (Figure 1), gray, and purple gums (Figure 2). Nevertheless, millions of subgingival margins are placed unnecessarily every year. Prepping subgingival margins to hide the color of teeth or the restorative margin, final impression challenges with the use of a double-cord technique, cutting healthy tooth structure for boxes and axial walls for resistance and retention form, and dropping the gingival floor to create cervical clearance are some of the difficult and often unsuccessful techniques associated with subgingival margins and the more traditional approach to restorative preparation design. Traditionally, restorative margins ending subgingivally are considered out of the control of the restorative dentist but, in reality, subgingival margins are mostly avoidable and preventable! We have the techniques and materials to be able to consider all of the above a part of the *history* of dentistry.

With the intentional goal of keeping the restorative margins supragingival, it is possible to predictably provide restorations that are healthier for patients. In the author's opinion, supragingival minimally invasive adhesive dentistry could, and should, fully replace traditional mechanically retained restorative dentistry.

This article will demonstrate, via 8 mini case reports, a minimally invasive supragingival protocol.

Figure 1. Typical appearance of gingiva around a full-coverage crown with subgingival margins. Note the inflamed and unnatural appearance.

Figure 2. Hiding dark teeth with opacious crowns usually leads to poor results, unhealthy and uneven gingiva, and the frequent remake of these crowns.

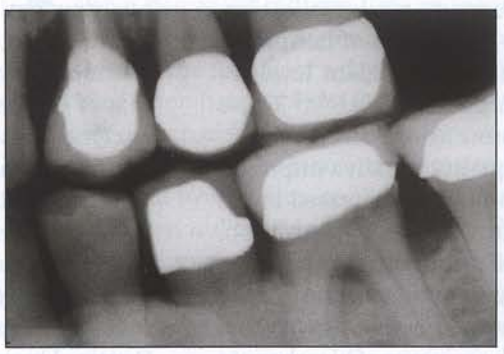

Figure 3. Radiograph showing deep and defective subgingival margins that had a negative effect on periodontal health throughout time.

Figure 4. Any clinician who plans to bond restorations on subgingival preparations knows how difficult and unpredictable this can be.

Side Effects of the Subgingival Margin

Subgingival open margins, overhangs, and their devastating consequences to our patients' periodontal health are the dirty little secrets of traditional restorative dentistry, as evident in Figures 1 to 3. Subgingival margins, on either direct or indirect restorations, double the chances of periodontal bleeding upon probing.[1] It is well known that calculus and root surface roughness have a very damaging effect on our patients' periodontal health; nevertheless, subgingival overhangs and open margins are at least as damaging, if not more, acting *as a permanent "tartar."*[2-4] Also, the aggressive tooth removal required for a mechanically retained restoration always causes some level of pulpal trauma and dramatically increases the chances for subsequent root canal therapy.[5]

Additionally, subgingival margins make both direct and indirect restorations more difficult and unpredictable for the restorative dentist. Subgingival margins very often mean bleeding gums, isolation problems, and the absence of a margin in enamel. With direct restorations, when margins are subgingival, placement of a matrix band, achieving isolation, and removing any excess material all become considerably more complex. With indirect procedures, subgingival margins are an even bigger problem. Taking an impression of a subgingival margin for any restoration is a most challenging procedure for dentists to perform, as the tissue-damaging double-cord technique is necessary,[6] and this is often defective on reproducing gingival margins.[7] Poor impressions lead to difficult and unpredictable laboratory work and defective restorations. Figure 4 shows a nightmare cementation scenario, as subgingival margins and bleeding gums led to very difficult and often unsuccessful isolation and cementation—especially when using adhesives and resin cement—often resulting in leaky margins on the final restoration.

A Majority of Subgingival Margins Are Preventable

Most subgingival margins are avoidable and manmade. Some of the reasons why dentists place subgingival margins unnecessarily are the following: aesthetics, traditional

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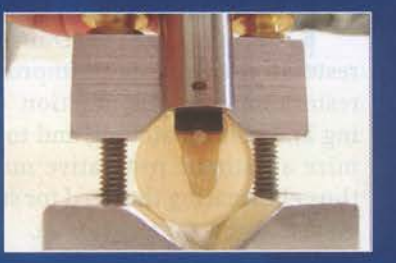
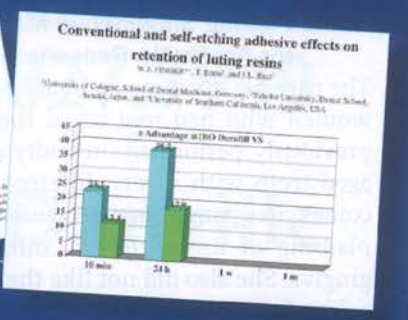
Dr. Ruiz has performed many research studies on adhesion and dental materials. Many have been presented at The International Association of Dental Research and American Association of Dental Research. He also has research articles published in journals like Compendium, Inside Dentistry and others. Dr. Ruiz has partnered on clinical and laboratory research with some of the leaders in dentistry: Dr. Gordon Christensen, Rella Christensen PhD, Dr. Werner Finger (inventor of Gluma, iBond, etc.), Al Kabashigawa PhD (inventor of Herculite & Optibond FL), as well as John Powers, PhD.

Following the same philosophy, the LA Institute research department, overseen by Dr. Ruiz, is actively involved in clinical and in-vitro research. They have invested heavily in the purchase of bond and fracture strength testing machines: (Ultratester), microscopes, etc. The research is focused on clarifying dentistry's most confusing clinical issues.





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restorative techniques, lack of trust in adhesion, and mistrust of bonded restoration when used with bruxing patients;[8-11] while trust in adhesion and using a supragingival protocol allows restorative dentists to break free from all of the above limitations.

Adhesive dentistry has changed the rules[12] and has allowed dentists to do things never considered possible before.[13-16] Adhesive dentistry has allowed dentists to break free of many of the rules established for mechanically retained restorations and develop new protocols. Implementing a supragingival protocol is indispensable for success with adhesive dentistry, because supragingival margins make adhesive dentistry easy and predictable; subgingival margins have the opposite effect. Additionally, and most importantly, it is much healthier for the patient.

Supragingival Protocol

For the past 10 years, a supragingival, minimally invasive adhesive dentistry approach has been taught at the Los Angeles Institute of Clinical Dentistry as a substitute for crowns and mechanically retained restorations. A supragingival protocol consists of *the 5 rules of supragingival dentistry:*

1. Careful removal of caries and old restorative material near the cervical margin to prevent unnecessary subgingival margins

2. Trust in adhesion and the avoidance of counterproductive boxes, ferrule, and other mechanical retention (when possible) that can cause subgingival margins

3. Supragingival enamel margin preservation techniques

4. Margin elevation technique[17]

5. Proper use of translucent restorative materials to improve the restoration-to-tooth junction blending and color matching and to minimize anesthetic restorative margins, thus eliminating the need for subgingival margins for any reason.

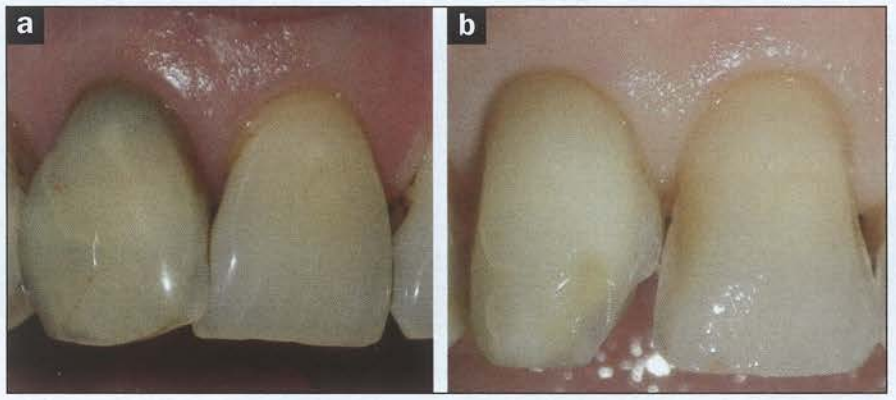
MINI CASE REPORTS 1 TO 3
Avoid Placing Subgingival Margins for Aesthetic Reasons

The patients in cases 1 and 2 are young women who had root canal therapy previously performed on badly damaged teeth with 2 very different outcomes. The patient in case 1 was complaining of unsightly red, inflamed gingiva. She also did not like the poor color of a traditional PFM crown with metal post and core and subgingival

Figure 5. *(Case 1)* The patient complained of puffy, purple gums around a single crown on her central incisor.

Figure 6. The new single central crown, showing healthier gingiva and improved aesthetics.

Figure 7. Five years later, gingiva has receded and the darkness of the tooth is starting to show, a common cycle in this type cases.



Figures 8a and 8b. *(Case 2)* **(a)** The right central is seen with a very dark cervical third; **(b)** after internal bleaching and composite repair of existing caries, before veneer cementation.

Figure 9. Immediately after veneer cementation. Note the supragingival margins that will allow for good gingival health and excellent aesthetics with good tooth-to-restoration blending.

Figure 10. *(Case 3)* The 14-year post-op of supragingival veneers showing good margin blending with tooth, periodontal health, and a very good future.

Adhesive dentistry has allowed dentists to break free of many of the rules established for mechanically retained restorations and develop new protocols.

margins placed 4 to 5 years previously (Figure 5). The usual technique, hiding a dark tooth and the margin of a PFM crown, had been done by placing the margin subgingivally. Once a tooth with a large metal post is cut for a crown, the options become very limited. A new crown was made with subgingival margins (Figure 6). As seen in the photo, the result of the replacement crown was acceptable, but some grayness around the margin was impossible to hide. Unfortunately, 5 years later, the gingiva was irritated and had receded as a result of the subgingival crown, making the margin visible (Figure 7) once again. This is unfortunately a common outcome that is totally preventable.

The patient in case 2 also had a very dark and damaged tooth. In this case, the tooth was treated using a supragingival minimally invasive protocol, including proper use of translucent restorative materials. In addition, the shade was also managed by using internal bleaching protocol described by Rotstein et al.[18] The caries and old restorations were repaired using bonded composite (CLEARFIL SE PROTECT and MAJESTY ES2 [Kuraray America]). The tooth and composite resin repairs were then prepared for bonded veneers using a supragingival preparation design (Figure 8). Thin translucent feldspathic porcelain (Noritake [Kuraray America]) veneers were then fabricated by a high-quality laboratory team (Burbank Dental Lab). The veneers were bonded with CLEARFIL SE PROTECT using an Accolade PV (Danville Materials) shade light. These veneers exhibited excellent translucency and an excellent blend of the margins (Figure 9).

The future of the tooth for the case 2 patient is much more promising. All possible tooth structure was preserved, and the gingiva would not be irritated by subgingival margins. Furthermore, gingival stability is expected; even when the gingiva recedes with age, the restorative margins will still be aesthetic, and the restoration and the tooth will likely have a much longer and healthier life.

Case 3 shows a patient who had bonded veneers performed for aesthetic reasons using supragingival principle No. 5 (proper use of translucent restorations to achieve good margin blending with supragingival margins). The feldspathic porcelain (Noritake) restoration was adhesively cemented with CLEARFIL SE BOND (Kuraray America) and a translucent resin cement (Nexus [Kerr]). The postoperative photograph, taken at 14 years, reveals gingival recession and restorative margin exposure. However, due to proper translucency, the restorations looked natural and did not need to be replaced, as is often the case with opacious restorations (Figure 10). Probably the most common reason that clinicians place subgingival margins is aesthetics and, as demonstrated by the previous 2 cases, it is preventable.

MINI CASE REPORTS 4 AND 5
Supragingival Enamel Margin Preservation Technique for the Direct and Indirect Restoration

Rule No. 3 of supragingival dentistry is very much represented by how the patient in case 4 was treated. A female patient had a large proximal caries on the distal of her second premolar, which clearly appeared to be deeply subgingival in the radiograph (Figure 11). This is a common problem, and with traditional restorative rules, the restorative outcome would result in

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having deep subgingival margins placed. The consequences of subgingival margins are quite undesirable, as composite resins and adhesives are intolerant to any contamination, subgingival preparations cause bleeding, and moisture control is very difficult. Additionally, it is much harder and less predictable to place matrix bands and wedges with subgingival margins and, in addition, to get a proper and reliable adhesive bond to this tooth structure. Again, many times, subgingival margins can be preventable by simply using a supragingival protocol.

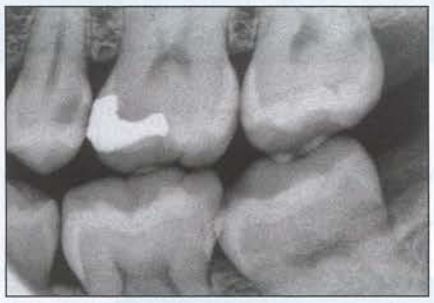

Figure 11. *(Case 4)* Radiographic view of a deep subgingival caries on distal of second premolar.

Supragingival margins are easier to isolate, restore, and finish, thus increasing the chances for an adequate long-term seal and overall success.

Figure 12. Sample tooth of enamel preservation in vitro study by the author, using calipers to measure enamel thickness.

Figure 13. Clinical view of the supragingival healthy enamel, but carious dentin.

When presented with a situation involving extensive and deep cervical caries, and when the enamel is healthy but the dentin is infected, a well-entrenched basic rule of cavity preparation is the removal of all unsupported enamel. This is because enamel is weak without dentin support.[19] On the other hand, thanks to adhesive dentistry, it is possible to choose to preserve the enamel without dentin support, to carefully remove the dentin caries, and to subsequently repair the unsupported enamel with properly bonded composite resin. Based on published evidence in the literature, it is reasonable to expect that the enamel will regain a large part of its original strength.[20-22] A soon-to-be-published in vivo research study (by the author) demonstrates excellent results with the enamel margin preservation procedure with 1.0-mm enamel thickness or more (Figure 12). This simple procedure, in comparison with a very difficult and unpredictable procedure when dealing with deep subgingival margins, makes the work more simple and predictable with supragingival margins. Supragingival margins are easier to isolate, restore, and finish, thus increasing the chances for an adequate long-term seal and overall success.

The patient in case 4 was treated using the enamel preservation technique. Careful removal of the gingival caries was done using Caries Finder (Danville Materials) to identify infected caries and to preserve the remineralizable affected dentin. Carefully preserving the full thickness of the healthy enamel above the gingiva by using this technique makes subgingival margins preventable (Figures 13 and 14). After caries removal, a matrix band (Slick Bands [Garrison Dental Solutions]) and a wedge (Wizard Wedge [Teledyne]) were placed. Again, it should be emphasized that simple and predictable placement and marginal seal are understandably much easier with the supragingival margins. An appropriate bonding procedure is also of great importance in cases like this. CLEARFIL SE PROTECT was applied and light cured. This was used because of its ability to minimize polymerization shrinkage, its excellent marginal seal, and low sensitivity and durability. Next, a thin layer of CLEARFIL MAJESTY FLOW (Kuraray America) was placed on the gingival floor and cured, followed by incremental filling and curing of the cavity using MAJESTY ES2. Removing gingival flash and finishing was also simpler due to the supragingival margin design. The radiograph shows the 2.0-mm deeper dentin floor compared to the supragingival enamel margin (Figure 15).

In case 5, for a female patient who required an indirect restoration on a

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Figure 14. After caries removal, still supragingival enamel after removal of all infected dentin.

Figure 15. Radiographic view showing results of enamel preservation and re-enforcement procedure.

Figure 16. *(Case 5)* Onlay preparation with a very deep distal caries.

Figure 17. Caries Finder (Danville Materials) identified infected dentin, and the healthy supragingival enamel was preserved.

Figure 18. After caries removal, the unsupported enamel was repaired; excellent isolation cervical isolation was achieved with a matrix band and wedge.

Figure 19. After enamel repair and buildup, all subsequent procedures will be easy and predictable, including final impression and bonded cementation.

Figure 20. *(Case 6)* A dentist treated with traditional crowns. She had experienced an all too common consequence of aggressive crown preparation—root canal therapy with subsequent post and core placement that, in this case, failed. She was told that the failure was associated with her severe grinding.

Figure 21. *(Case 7)* A 30-year-old female with severe occlusal disease, showing dramatic incisal edge wear.

Figure 22. Supragingival, minimally invasive veneer preparations.

Figure 23. The 6-year postoperative view, showing the routine success of healthy and tooth preserving bonded restorations, combined with proper occlusal management.

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badly damaged tooth (Figure 16), a minimally invasive onlay was chosen to preserve as much as possible of the remaining tooth. After occlusal reduction and removal of the caries using the Caries Finder (Figure 17), supragingival enamel margin preservation and margin elevation procedures were performed using similar techniques as the previous case (Figure 18). Then an impression was taken using a highly hydrophilic impression material (Panaseal [Kettenbach LP]). Next, a provisional was fabricated using Visalys Temp (Kettenbach LP) and then cemented with Temrex TNE (Temrex). A lithium disilicate (IPS e.max [Ivoclar Vivadent]) onlay was fabricated by our laboratory team, and the restoration was then resin cemented with CLEARFIL ESTHETIC CEMENT (Kuraray America). The photo in Figure 19 was taken before cementation, showing healthy supragingival gingiva. Healthy and nonbleeding gums make the any cementation protocol easier and less stressful.

Figure 24. *(Case 8)* A Polaroid photo of a 48-year-old male patient with severe wear seeking treatment.

A better, healthier approach for patients is the supragingival restoration, whether it be porcelain or composite resin.

Figure 25. The 17-year post-op photo of rehabilitation done with a bonded onlay and veneers with supragingival preparation designs.

MINI CASE REPORTS 6 TO 8
The Solution for Worn-Out Teeth is Not to Cut Them for Crowns

In a logical world, it would sound counterintuitive to repair or restore badly worn-out teeth by aggressively cutting the tooth further for a crown. This process further removes vital supporting structure, further weakening the teeth. Nevertheless, this is exactly what continues to be promoted and is still considered "ideal" treatment by many.[23,24] The rationale presented is that bonded onlays and veneers have a higher failure on in vitro testing and shorter clinical life with worn-out teeth and patients with bruxism. Nevertheless, it is also known that any type of tooth-colored restoration, including full-coverage, will deteriorate and have a shorter life span with these patients. Additionally, the literature and much personal clinical experience shows great success treating the worn dentition with bonded onlays and veneers.[25,26] A better, healthier approach for patients is the supragingival restoration, whether it be porcelain or composite resin. Case 6 depicts a dentist who was treated by a prosthodontist with a full-mouth rehabilitation, with aesthetic goals in mind, using full-coverage crowns to restore damage from severe wear. Less than 5 years postoperatively, the consequences of aggressive tooth preparation and subgingival margins became evident with catastrophic failure of some anterior restorations and the teeth associated with them (Figure 20).

For the past 10 years, the Los Angeles Institute has been teaching a minimally invasive approach to rehabilitating the worn dentition. This has included learning the proper management of occlusal disease[27] and knowing science-based occlusal principles, such as the 3 Golden Rules of Occlusion.[28] With trust in adhesion, as well as a good understanding of the restorative materials to be used, a healthier minimally invasive rehabilitation of the worn dentition can be done with excellent results.

Case 7 is a 30-year-old female patient who presented with severe occlusal disease (Figure 21). She wished to restore anterior teeth primarily for aesthetic reasons. A traditional approach would have been to prepare for full-coverage crowns, requiring the removal of approximately 75% of coronal structure and usually the placement of subgingival margins. Instead, minimally invasive supragingival preparations where performed. Figures 22 and 23 show the patient at 6 years postoperatively.

The patient in case 8 presented in 1997 with severe wear and other signs of dynamic and untreated occlusal disease (Figure 24). A full-mouth rehabilitation, using bonded onlays and veneers with a feldspathic porcelain (Noritake) was performed. Figure 25 is a 17-year postoperative photo.

CLOSING COMMENTS

The mini case reports presented herein demonstrate why aggressive tooth preparations and subgingival margin placement should be questioned. Subgingival margins are preventable, thanks to advances in dental materials and modern techniques.✦

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Disclosure: Dr. Ruiz reports no disclosures.