Supragingival Dentistry
Using Metal-Free Restorations

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LEARNING OBJECTIVES:

After reading this article, the individual will learn:

- The disadvantages of subgingival margins and how to avoid them using nonmetal restorations.
- Clinical requirements of nonmetal restorative options and how to create aesthetic supragingival margins.

ABOUT THE AUTHOR

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INTRODUCTION

One of the main advantages of nonmetal indirect restorations is the placement of supragingival margins. Traditional porcelain-fused-to-metal (PFM) crown margins must be placed subgingivally for aesthetic purposes, making impression taking and cementation very challenging, even for experienced clinicians. Keeping crown margins supragingival makes these procedures easier and more predictable. This represents an advantage that is in addition to the improved aesthetics achieved with non-metal indirect restorations.

The increased use of and interest in bonded porcelain and resin composite restorations have been stimulated by patients’ increased demand to have natural-appearing restorations. Over the years newer and more aesthetic materials have become available, and the dental profession has been able to meet patient demand for these natural-appearing restorations. Nevertheless, familiarity with new, material-specific techniques have not kept up with the introduction of new materials. As a result, some clinicians may not be using these materials to their full potential and fail to take advantage of important benefits that new restorative materials offer.¹

This generation of newer restorative materials can result in more predictable restorations, since they allow clinicians to create restorations with supragingival margins. This article discusses the benefits of “supragingival dentistry” and some of the techniques for maximizing clinical success. Clinical examples are presented to clarify this concept.

WHY DO WE NEED SUPRAGINGIVAL DENTISTRY?

One of the most challenging procedures in dentistry is the impression of a subgingival margin for a PFM crown.² Subgingival crown preparation margins are required on PFM crowns to achieve an acceptable aesthetic outcome. Christensen has called attention to the difficulties associated with impressions for fixed prosthodontic restorations; some laboratories admit that 85% to 90% of the impressions they receive have poor marginal definition.³ Poor impressions, errors during laboratory processing, and errors associated with subgingival cementation often result in poor clinical outcomes. Placement of subgingival margins is one of dentistry’s biggest problems, posing challenges in terms of placement of the retraction cord, capturing a good impression of the margins, and managing the soft tissues during cementation.

The following case report demonstrates the complications that can be associated with placement of subgingival margins.

CASE REPORT

A patient presented with a complaint of oral malodor associated with her mandibular right first molar. A PFM crown had been placed 2 years before. The patient was satisfied with the aesthetics, but was concerned with the odor and taste and was willing to have it replaced (Figure 1). A radiograph demonstrated open margins (Figure 2). After crown removal, subgingival margins were
evident; in some areas the margin was more than 2 mm below the gingival margin. The tooth preparation was aggressive, but it was evident that an attempt was made to define the margins and that taking the impression and cementing this restoration was difficult, and ultimately unsuccessful. The use of 2 retraction cords and an aggressive packing technique were required to uncover the margin and take an acceptable impression of this tooth. Cementation of the re-placement crown was also difficult and required cord packing (Figures 3 to 5).

One of the consequences of subgingival margin placement is difficulty in isolation during crown cementation and microleakage of the restorations immediately after insertion. Caries may also develop after cementation, and this usually goes undetected for years. Further, poor gingival health is often observed around PFM crowns. A subgingival margin is associated with poor gingival response, and poor marginal adaptation can have a devastating effect on periodontal health. Another disadvantage of a traditional full gold crown or PFM crown is the need to remove healthy tooth structure for retention purposes. A more conservative preparation will be farther from the pulp, decreasing the likelihood of an adverse pulpal response. Properly fabricated nonmetal restorations will often allow the use of supragingival margins, improving aesthetic results and making the clinical outcome more predictable.

An important characteristic of all nonmetal restorations is translucency. Translucency allows for an aesthetic blend of the restoration and the tooth due to light passing through the restoration and into the tooth. Some nonmetal restorative materials are more translucent than others. For example, layered and pressable feldspathic porcelain are very translucent, while alumina and zirconia are much more opaque, but still are translucent.

As noted, translucency allows for a more aesthetic restoration. Enamel and dentin function as fiber-optic rods; when light strikes the crown of the tooth it passes down the root. Traditional metal-ceramic restorations (even those with porcelain margins) are completely opaque, thus preventing light from passing into the tooth and root. This results in a root that appears dark, and the margin appears gray; even the gingiva appears gray (Figure 6). Non-metal restorations permit light to pass into the tooth and root, thus...
the shadowing effect of the metal coping is eliminated or diminished. When using highly translucent feldspathic porcelain clinicians can achieve a “contact lens” effect, making the margin disappear. As a result there is no need to hide the margin subgingivally. When using a more opaque zirconia crown the margin can safely be placed at the gingival margin in the aesthetic zone. Even if the margin becomes visible (eg, due to gingival recession), it will still be aesthetically acceptable. Gingival recession is less likely to occur when gingiva is not being damaged with heavy cord packing or irritating subgingival margins. In nonaesthetic areas the margin can be left supra-gingival. As a result, the traditional gray margins associated with PFM crowns are eliminated (this assumes that the zirconia crowns are made correctly), and margins can be placed supragingivally while still achieving acceptable aesthetic results.

Another important benefit of a supragingival margin is preservation of tooth structure during tooth preparation. The effect of apical placement of margins is that the more apical the margin, the more tooth structure must be removed to maintain the same margin width and taper; this is due to the narrowing of the root and the needed taper of the preparation, as explained by Schillinburg (Figure 7). Other benefits of margins that are supragingival or at gingival level include the following: (1) impressions are more predictable, with minimal or no cord packing; (2) provisional restorations are easier to make, and the soft tissues will be healthier when the patient returns for cementation of the final restoration: and (3) removing excess cement is much easier when the margin is visible, eliminating the common problem of leaving small amounts of cement subgingivally. An additional important benefit is better overall gingival/periodontal health.

When placing supragingival margins, different clinical rules apply for bonded feldspathic porcelain versus full zirconia crowns, and for the highly aesthetic zone (anteriors and bicuspids) versus the molar regions.

**HOW TO MAXIMIZE CLINICAL OUTCOMES USING FELDSPATHIC PORCELAIN**

Layered and pressed feldspathic porcelain is the most aesthetic option available, and for that reason it is the ideal material for porcelain veneers and onlays or inlay/onlays. Restorations using layered porcelain, and to a lesser extent pressed porcelain, can have different shades and opacities throughout the restoration, closely approximating the appearance of an unrestored tooth. In addition, feldspathic porcelain can be highly translucent. Translucency allows for a very good blend between the natural tooth and the restoration, which in turn allows for coronal placement of the margin. Further, feldspathic porcelain must be cemented with resin cement, and resin cements have no tolerance for contamination. Isolation of subgingival margins is very difficult and could lead to contamination of the bond and early failure of the restoration. Therefore, placing margins subgingivally, as is needed for PFM crowns, is generally contraindicated for all-ceramic crowns. The following case report demonstrates the problems that can result from subgingival margins when luting all-ceramic crowns with resin cement.

**CASE REPORT**

A female patient (who was a dentist) had alumina (all-ceramic) crowns placed on the 4 maxillary anterior teeth approximately 3 years prior by a prosthodontist who prepared the crown margins 1.5 mm below the gingival margin. The crowns were cemented with a total-etch resin
Because it is difficult to fully isolate subgingival margins for cementation, and resin cement is unforgiving, there was immediate microleakage, chronic tooth sensitivity, and eventual necrosis of the pulp in 2 of the 4 teeth (Figures 8 and 9).

In any region where aesthetics is a primary concern, it is desirable to leave the preparation margins of feldspathic porcelain veneers and porcelain jacket crowns 0.5 mm above the gingiva or at the gingival level (Figure 10). Making sure that the restoration color is not dramatically different from the natural tooth color is an important first step; for this reason it may be appropriate to bleach the teeth before beginning a highly aesthetic restoration procedure. Communicating with the laboratory regarding the level of desired opacity is a key to success. For example, the darker the tooth that is being restored, the more opacity that will be required in the porcelain.

In the posterior area of the mouth (bicuspid and molar teeth), nonmetal on-lays are a very desirable restorative option because they allow use of a preparation that conserves tooth structure and placement of a supra-gingival margin. Further, significant evidence substantiates the excellent clinical results of nonmetal onlays. It is, however, important to use the restorative material correctly to achieve good marginal blend with nonmetal onlays. The use of a “hybrid onlay” using VenusCeram (Heraeus Kulzer) pressed and layered porcelain has been described and can yield excellent aesthetic results (Figures 11 and 12). Good results may also be obtained with layered laboratory composite such as belle-Glass (Kerr Lab). By properly using this aesthetic restorative material the margins of the restoration can be placed well above the gingiva in these less aesthetically demanding areas, thus allowing for maximum tooth preservation and meeting aesthetic requirements.

**HOW TO MAXIMIZE CLINICAL OUTCOMES USING ZIRCONIA CROWNS**

Alumina and zirconia crowns are considerably more opaque than feldspathic porcelain, but they are still translucent. The degree of translucency of these restorations can be controlled by the thickness of the zirconia coping and the type of veneer porcelain that is used.
applied on top of this coping. Compared to alumina, the superior strength of zirconia copings allows for fabrication of thinner, more translucent copings. As a result, zirconia copings are preferable to alumina copings, as the latter must be thicker to provide adequate strength and the thickness makes them more opaque. In order to achieve maximum translucency, it is important to communicate to the laboratory the desired thickness of the coping. The LAVA zirconia system (3M ESPE) has an important aesthetic advantage because copings can be fabricated in different colors. This improves aesthetics (less space is required for porcelain), and less tooth preparation is required. For anterior teeth it is desirable to request a 0.3-mm coping, with the addition of 0.8 mm of veneer porcelain for aesthetics. It is then possible to prepare a 1.1-mm-deep chamfer with the margin at the gingival level.

The following case report demonstrates the benefits of supragingival margins using all-ceramic zirconium crowns

**CASE REPORT**

A female patient presented needing a fixed bridge to replace a missing maxillary lateral incisor. The patient was in her mid 20s and had high aesthetic expectations; in her case an implant was not an option due to convergent tooth roots after orthodontic treatment and her unwillingness to have the roots separated orthodontically. The preparation needed for an all-ceramic zirconium crown on the right central incisor required only 1.1 mm of reduction, with the margin at the gingival level. There was an excellent aesthetic result (Figures 13 and 14). In the posterior area (molars and premolars) the coping must be 0.5 mm thick, therefore the preparation for the posterior teeth should be a minimum of 1.3 mm axial reduction; the margins can be left 0.5 to 1 mm supragingivally (Figure 15). To achieve the correct amount of reduction, the clinician can use a tapered chamfer diamond bur with a working tip of 1.1 mm or 1.3 mm as needed. Although the margin is visible, it is usually not unsightly, and patients tolerate it well. This placement makes taking the impression, fabricating the temporary restoration, and cementing the final restoration easier and more predictable.

It is important to note that in order for all-ceramic zirconium crowns to be more translucent and thus allow margins to blend better with the tooth, a coping with the correct thickness is essential. Further, it is important for the laboratory technician to understand the principles of translucency. Laboratory technicians may transfer their traditional concept of how to apply veneer ceramic on top of a zirconia coping from their previous experience with PFM crowns. In that case they will first apply opaquer, followed by dentin opacious ceramic, and finally a layer of more translucent enamel ceramic. Technicians must understand that all-ceramic zirconium crowns, especially LAVA crowns with the correct coping color, do not need an opaquer layer. In addition, it is preferable to use more translucent veneer material, otherwise the benefit of translucency is lost. Further, technicians must design zirconia copings correctly to avoid leaving unsupported porcelain on the marginal ridges, which will minimize veneer porcelain fractures.
CONCLUSION

The techniques used for mechanically retained PFM crowns are often associated with clinical complications that may lead to restoration failure. Providing patients with nonmetal indirect restorations provides more than an aesthetic benefit. By utilizing the concept of supragingival dentistry, clinicians may be able to provide better crown margins and restorations that protect gingival health, preserve more natural tooth structure, and improve the outcome of reconstructive dentistry.

REFERENCES

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**POST EXAMINATION QUESTIONS**

1. Which of the following is a true statement?
   a. Subgingival impressions are easy.
   b. Laboratories report that the majority of impressions submitted have excellent marginal reproduction.
   c. Subgingival impressions are difficult and often unsuccessful.
   d. Subgingival impressions are necessary with all-ceramic restorations.

2. Advantages of crowns with supragingival margins include:
   a. improved oral hygiene
   b. easier tooth preparation
   c. improved retention
   d. a and b above

3. Compared to layered and pressable feldspathic porcelain restorations, which may be very translucent, alumina and zirconia restorations are ______.
   a. equally translucent
   b. more opaque, but still translucent
   c. highly opaque and not translucent
   d. minimally opaque and highly translucent

4. Traditional metal-ceramic restorations do not provide ideal aesthetics because:
   a. metal ions leach out into the tissue over time
   b. metal can be toxic for cells of the periodontal ligament
   c. the required luting agents are opaque
   d. metal is opaque, preventing light from passing into the remaining tooth structure

5. Preparation reduction on an anterior tooth for the use of an all-ceramic zirconium crown is 1.1 mm. What is the minimum amount of reduction needed for a posterior tooth?
   a. 1.2 mm  b. 1.3 mm  c. 1.4 mm  d. 1.5 mm

6. One benefit of using a LAVA zirconia system for improving aesthetics is _____.
   a. laboratory fabrication is easy
   b. copings come in multiple colors
   c. the restorations are easily contoured in the mouth
   d. very bright shades of white are available

7. All-ceramic zirconium crowns, compared to PFM crowns, do NOT require which of the following steps/materials for laboratory fabrication?
   a. opaquer
   b. dentin opacious ceramic
   c. translucent enamel ceramic
   d. final polish

8. By utilizing the concept of supra- gingival dentistry described in this article, the clinician will benefit by _____.
   a. simpler impression technique
   b. better gingival health
   c. easier cementation
   d. all of the above
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