Diagnostically Generated Anterior Tooth Preparation for Adhesively Retained Porcelain Restorations: Rationale and Technique

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ABSTRACT

A diagnostically based protocol for anterior tooth preparations for adhesively retained porcelain restorations offers dentists and laboratory technicians new options to approaching these restorations. Rather than designing a preparation and restoration based more on the needs of the products used than on the preservation of the remaining tooth structure, practitioners can enhance the predictability of these restorations by concentrating simultaneously on three distinct zones of the tooth (incisal, middle, and cervical) and four diagnostic categories (periodontal, biomechanical, functional, and dentofacial). The result of following the technique presented in this article is achieving an individualized design that offers a predictable option with minimal risks to the remaining tooth structure.

Although technically demanding and product-dependent, porcelain laminate veneers offer a predictable option for creating a successful restorative treatment that also preserves a maximum amount of tooth structure.[1-5] The risk of failure, however, has been shown to increase when primarily bonding to dentin rather than enamel, when the functional relationships are not managed properly, or when the tooth structure to be restored is very dark.

Concepts of anterior tooth preparation for these restorations continue to evolve, creating confusion among restorative dentists and laboratory technicians. Unfortunately, this confusion tends to result based more on the needs of new and innovative products, which is commercially biased, rather than on concern about remaining tooth structure.

In contrast, a rationale that is diagnostically based provides the opportunity to create a framework of understanding that will enhance the predictability of these restorations in tandem with the improvements and benefits from new technologies. To create a restoration that exceeds patients' expectations with minimal compromise to remaining or existing tooth structure, the parameters of anterior tooth preparation are focused on three distinct zones: incisal, middle, and cervical.

Within each zone, the tooth preparation is generated by simultaneously understanding the biomechanical behavior of the tooth structure, functional requirements, dentofacial parameters, and the periodontal concerns of the patient. Therefore, the ultimate design of the tooth preparation is minimized by the needs dictated by product thickness and maximized to benefit the final restorative result (**Figures 1 through 6**).

Incisal Zone

Representing the initial starting point, restoration of the incisal zone is based primarily on the functional and esthetic requirements of the individual patient. If the incisal edge position is correct in the face and in harmony with the smile, no vertical tooth reduction is necessary. This, unfortunately, does not provide the laboratory technician any flexibility to modify shape, position, or incisal translucency.

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Figure 1. Preoperative facial view of teeth Nos. 7 through 10 shows significant discoloration and incisal edge fracture on tooth No. 8.

Figure 2. Radiograph of teeth Nos. 7 through 10 shows large endodontic access opening and fill in tooth No. 8, which is a high biomechanical risk.

Figure 3. Preoperative lingual view. Note extent of fracture and position of lingual finish line.

Figure 4. Final tooth preparation on No. 8. There is excessive reduction of the incisal edge on the mesial (dictated by fractured), butt-fit margin design, and a more excessive cervical reduction (0.7 mm) because of the high dentofacial risk and low periodontal risk.

Figure 5. Preoperative facial view of teeth in occlusion.

Figure 6. Final view in occlusion. The veneer on tooth No. 8 is adhesively retained primarily to enamel, which is not perfect esthetically. However, maximum preservation of tooth structure for a predictable long-term result was accomplished.

Figure 7. Preoperative facial view of teeth Nos. 7 through 10 shows hopeless prognosis for tooth No. 8 and discolored interproximal composites.

Figure 8. Preoperative incisal view of functional relationship shows slight malposition of teeth Nos. 9 and 10, low functional risk.

Vertical reduction is not desirable, however, if the functional risk is high. If functional risk is low, the dentist has more flexibility to develop incisal reduction based on esthetic dentofacial veneers (**Figures 7 and 8**).

Reduction Considerations

Ideally, the vertical incisal reduction is 2.0 mm from the desired position, where it does not create a biomechanical compromise to the remaining tooth structure. It also offers minimal functional risk to the porcelain extending beyond the incisal edge, and gives the laboratory technician esthetic options to alter tooth form and build incisal effects in the porcelain. In addition, strict guidelines about not reducing the incisal zone more than 2 mm vertically as discussed in previous arti-

Table 1

Incisal Zone

Key: Develop optimal incisal position of esthetics and function

Objective: 2.0-mm vertical reduction

Margin Design: Butt
Lingual finish line in enamel

Instrumentation: 330 Mw[α]
KS 0 Medium[α]
KS 7[α]

Consider Alteration of Incisal Zone Reduction When:

Example 1 Use less reduction if:
Low-risk dentofacial
High-risk function

Example 2 Use more reduction if:
High-risk dentofacial
Low-risk function

[α]Brasseler USA, Savannah, GA 31419; 800-841-4522

cles are not supported by clinical findings. Unsupported vertical incisal porcelain even greater than 4 mm is predictable if the angle of anterior guidance and envelope of function are controlled (**Table 1**).

Margin Design

Most practitioners recommend a lingual chamfer margin design, which is acceptable, although it is not ideal.[6] It appears more prudent to develop a butt margin design incisally, with its lingual component in enamel and its facial axial line angle rounded. This allows the technician an opportunity to blend the porcelain so that the outline of the preparation will never be visible facially. In addition, the technician and dentist will then have multiple paths of insertion, for simplicity (**Figures 9 through 12**).

Middle Zone

The key concern for this zone is performing minimal facial reduction that retains tooth structure comparable to the retained enamel to optimize the limitations of composite technology. This will provide a unique blend of stiffness vs. flexibility and preserve the biomechanical behavior of the original tooth.[7-12] Unfortunately, this must be balanced by the need to create sufficient porcelain thickness, which is required for optimum esthetic development.

Figure 9. The Brasseler tooth preparation kit system (Brasseler USA, Savannah, Ga.) includes all of the burs necessary for tooth preparation and insertion of indirect restorations.

Figure 10. Facial view of tooth preparation technique for adhesively retained porcelain restorations. Step 1, incisal zone. Incisal edge reduction depth cuts with a 330 MW.

Figure 11. Facial view, step 1, incisal zone. Gross reduction using a KS 7 (Brasseler USA, Savannah, Ga.) bur.

Figure 12. Facial view, step 1, incisal reduction complete. Note that the vertical reduction is slightly less than the ideal 2 mm because of the need to increase the length of the final result based on dentofacial parameters.

The mean facial enamel thickness in the middle zone is 0.8 mm to 0.9 mm.[13] Therefore, while facial reduction less than this amount is desirable, maintaining the thickness of porcelain less than this amount will create many challenges for the laboratory technician and eliminate options for any core-supported systems.

Reduction Requirements

To maintain enamel facially and recreate the original biomechanical behavior of the tooth, a 0.5 mm to 0.7

Table 2

Middle Zone

Key:	Maintain enamel Minimal structural compromise
Objective:	0.5-mm to 0.6-mm – normal-colored teeth reduction 0.7-mm to 0.9-mm – darker-colored teeth reduction Bevel facial incisal edge Proximal finish lines in enamel

Margin Design:

Option 1	Maintain contact point if no proximal restorations
Option 2	Open contact point if previous caries restorations or to change tooth form

Instrumentation:
KS 0 depth guide = 1/2 Diameter 0.5 mm
KS 7 – gross reduction
KS 0 – complete remaining preparation

Consider Alteration of Middle Zone Reduction When:

Example	Dark-colored tooth High-risk biomechanics High-risk function High-risk dentofacial Use 0.6-mm to 0.7-mm facial reduction

mm reduction is ideal. Interproximal finish lines should be terminated in enamel to minimize microleakage, and all sharp corners should be eliminated to minimize stress concentration in the porcelain as well as seating concerns for the restoration. Based on functional relationships, as much lingual enamel as possible should be preserved to minimize opposing wear. Dentofacial parameters contribute to significant concerns based on a preference for using only a clear resin-luting agent to develop imperceptible restorations.

For normal-colored teeth providing one or two levels of shade change (e.g., A3 to Al), reduction requirements of 0.5 mm to 0.7 mm are sufficient. However, for tetracycline-stained or very dark teeth, the maximum reduction of 0.8 mm to 0.9 mm is more prudent.

As usual, and especially in these situations, the individual talents of the laboratory technician are far more important than the specific brand of porcelain used. An understanding of the layering techniques, fluorescence, and optical properties of the materials used is essential.

In addition, the clinician must decide whether to maintain or eliminate the proximal contact from a dentofacial perspective. This decision may be based solely on the need to alter the tooth form or shape. This allows proper space distribution and the creation of teeth in proper proportion. From a biomechanical perspective, previous proximal restorations will necessitate more significant reduction to allow the finish line location that terminates on enamel lingually (**Table 2**).

Margin Design

The facial incisal aspect of the preparation must be rounded and beveled slightly to create an invisible transition of porcelain to the incisal edge and to eliminate stress concentration and seating concerns. All other aspects maintain a butt type of finish line (**Figures 9 and 13 through 15**).

Cervical Zone

The key concerns in this zone are similar to those in the middle zone except that the enamel is only 0.3 mm to 0.4 mm thick. In addition, the periodontium complicates the management. The preferences to maintain enamel, control color, alter tooth form, minimize flexure, and preserve biologic width combine to provide additional unique challenges to the laboratory technician and clinician.

Reduction Requirements

To preserve enamel, ideal reduction should be no more than 0.3 mm to 0.4 mm. This minimizes microleakage resulting from more predictable enamel bonding and minimizes the biomechanical compromises to the remaining tooth structure. This is especially critical with endodontically treated teeth. The larger the access opening and the greater the removal of internal tooth structure, the more critical the concerns for cervical reduction. This is especially a concern for a high-risk functional patient where tooth flexure is potentially greater.

Biomechanically and functionally, the minimal cervical reduction requirements are often at odds with the dentofacial concerns. When the teeth are normal color, a 0.3-mm reduction remains ideal for the porcelain to perfectly blend in, creating the contact lens effect. This is only true, however, with clear luting cement. Unfortunately, when teeth are darker than A3 and the requirements for the patient dictate using A1 or B1 shades, more re-

Figure 13. Lateral view, step 2, middle zone. Facial reduction depth guide using a KS 0 medium bur. Note that this is approximately half the 1.0 mm diameter.

Figure 14. Facial view, step 2. Completion of facial depth guide using a KS 0 medium bur. Note that this step does not include the cervical zone.

Figure 15. Lateral view, step 2, middle zone. Gross reduction using a KS 7 super-coarse bur.

Table 3

Cervical Zone

Key:	Preserve enamel
	Esthetics requirements
Objective:	0.3-mm reduction requirement for normal-colored tooth
	0.6-mm to 0.9-mm reduction for dark- to very dark-colored teeth
Margin Design:	
Option 1	Supragingival margin location • Normal tooth color • Minimal change in tooth form
Option 2	Intracrevicular location • Dark color • Change shape • Close gingival embrasures
Instrumentation:	KS 0
Consider Alteration of Cervical Zone Reduction When:	
Example 1	High-risk periodontal High-risk dentofacial Low-risk biomechanics Low-risk function Axial reduction 0.3 to 0.9 mm Intracrevicular margin location May be primarily in dentin
Example 2	High-risk biomechanics High-risk function Low-risk function Low-risk periodontal 0.3-mm supragingival margin location Will be in enamel

duction is necessary. As a general guideline, an additional 0.2 mm of reduction is necessary for each additional shade change.

Obviously, these increased reduction requirements compromise the biomechanics and functional concerns of the teeth. Therefore, the dentist must decide where to develop the most appropriate compromise. The priority in this decision is dictated by the individual tooth and patient concerns, not by the needs of the restorative material (**Table 3**).

Margin Design

From a periodontal perspective, supragingival margins are ideal. Concepts of intracrevicular tooth preparation have been previously discussed[14,15] and are not any different for these restorations. From a biomechanical perspective, the actual configuration of the finish line exhibits little influence on stress variation in the porcelain. The most significant factor in minimizing marginal failure is ultimately the luting layer (**Figures 9, 16, and 17**).[16,17]

Summary

This article presented a diagnostically generated protocol for anterior tooth preparation for adhesively retained porcelain restorations. This approach eliminates a standardized design based solely on the requirements of restorative materials. By shifting the focus to three distinct zones of the tooth and four diagnostic categories of periodontal, biomechanical, functional, and dentofacial parameters, the clinician can create an individualized design. Therefore, this design is deter-

Figure 16. Occlusal view, step 3, cervical zone. Reduction with KS 0. Previous restorations were removed. The implant healing abutment is visible on tooth No. 8.

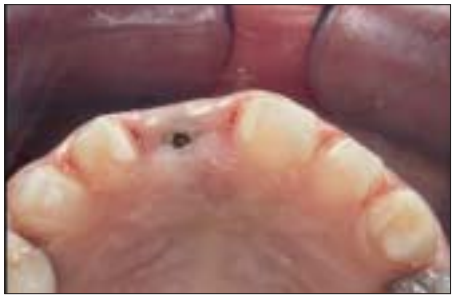

Figure 17. Occlusal view, step 3, cervical zone. Reduction is complete, and all restorations are replaced. Note that all margins terminate in enamel.

Figure 18. Facial view of teeth Nos. 6 through 11, at time of delivery from the lab. The implant restoration on tooth No. 8 was fabricated with a custom abutment and the metal-ceramic crown was veneered with Duceram (Ducera Dental GmbH and Co. KGJ, Germany) to match the adjacent feldspathic Duceram veneers.

Figure 19. Facial view of teeth Nos. 6 through 11, final result. Note adhesively retained porcelain restorations on teeth Nos. 6, 7, 9, 10, and 11. The implant-retained metal-ceramic crown on tooth No. 8 was completed simultaneously.

mined based on the need to minimize risk in the highest risk categories. With this approach, dentists can achieve the best possible result with minimal risks to the remaining tooth structure and the best chance for longevity (**Figures 18 and 19**). CDA

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