



The Influence of Tooth Color on Preparation Design for Laminate Veneers from a Minimally Invasive Perspective: Case Report



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Various types of dental preparations for laminate veneers have been proposed, depending on factors such as the properties of the ceramic material, remaining dental structure color, need for altering the dental contour, laboratory fabrication technique, and occlusal relationships. Clinical observations of successes and failures associated with the development of techniques and materials have allowed some safe parameters to be delineated for effectively performing dental preparations for ceramic veneers or even placing veneers without any preparation. This article describes the use of an additive diagnostic wax-up that is transferred to the mouth by means of an intraoral mock-up (aesthetic pre-evaluative temporary) with associated mathematic parameters to guide dental preparations. This technique, called Do the Math and presented here in the form of a clinical case report, aims to avoid excessive or incorrect tooth preparation by indicating the exact amount and location of the tooth reduction necessary to attain the desired color and shape. (Int J Periodontics Restorative Dent 2014;34:453–459. doi: 10.11607/prd.1900)

Ceramic veneers are highly esthetic restorations with predictable outcomes when placed based on appropriate indications.^{1–5} Various dental preparation designs for veneers have been proposed and have depended on factors such as the properties of the ceramic material, color of the remaining dental structure, need for altering the dental contour, laboratory fabrication technique, and occlusal relationships. In addition, the concepts and skills of the restorative dentist together with technician expertise had significant influence on the definitive result. Over the course of time, clinical observations of successes and failures,^{6–9} associated with the development of techniques and materials, have allowed some safe parameters to be delineated for effectively performing,^{10,11} or not performing,^{12–14} dental preparations for the placement of ceramic veneers.

Preparations for laminate veneers may be divided didactically into three generations. In the first generation (depth guide generation),^{15–17} diamond burs of preestablished depths are used to perform

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the preparation, which has standardized measures for reduction on the buccal surface and incisal portion. This generates a non-individualized and generally overly aggressive preparation. It is an acceptable technique when one desires the final contour to be similar to the initial contour of the tooth, with discreet anatomical and/or color alterations. It is important to point out that in a significant number of veneer cases, the patient has lost dental structure due to abrasion, erosion, or attrition and needs to have this lost volume reestablished. If the thickness of enamel and dentin lost is not diagnostically restored in the wax-up and mock-up before preparation, unnecessary reduction might be done on the remaining tooth structure. Thus, this concept of dental preparation does not consider the volume that could be reestablished or even added, and the tooth is simply prepared until a uniform thickness of restorative material, defined by the remaining tooth structure, is obtained.

The second generation (silicone index generation)^{18–20} recommends analysis and planning of the dental preparation by means of a diagnostic wax-up on the cast and the fabrication of silicone indexes on the wax-up, taking into consideration the final dimensions of the tooth. The silicone indexes are used in the mouth to guide the amount and location of preparation. Nevertheless, the preparation is still performed freehand and demands constant reevaluations with the indexes until the tooth preparation has been concluded.

The third generation (mock-up and prepping the tooth by means of the aesthetic pre-evaluative temporary [APT] method)^{1,21–23} is the technique currently recommended by the authors for tooth preparation for laminate veneers. The goal is to completely reestablish or even increase tooth volume up to the point allowed by esthetics, function, and prepping through the APT, which is used as an exact guide.²³ Thus, the more volume that could be added, the more conservative the preparation would be. In order to obtain a customized and predictably successful preparation with veneers, two questions must always be kept in mind: (1) To what extent can tooth volume be increased? (2) How thin can the veneer be? The answers to these questions will indicate the required thickness of the dental preparation and consequently how much enamel will be preserved.²³ The first question is answered with the aid of the mock-up, which can be built directly in the mouth or with the APT obtained from the diagnostic wax-up, followed by esthetic and functional concepts. The answer to the second question mainly depends on the actual color of the remaining tooth structure and the final color desired. Therefore, in order to know the exact amount of tooth reduction, we will have to perform a mathematic operation:

$$EV - LT = P$$

where *EV* represents the extra volume achieved with the mock-up; *LT* is the laminate veneer thickness

required according to the initial and final color, and *P* represents the amount of preparation.

This article presents the technique called *Do the Math*, used in conjunction with the third generation of preparations, relating the color and final contour of the restoration to the dental preparation and thickness of the ceramic laminates.

Case Report

The patient, a middle-aged man, presented to the author's private practice with complaints about the color and size of his teeth and incisal embrasures that were too open (Fig 1). A comprehensive examination of the relationship between the patient's teeth, smile, and face was performed. The inclination of the teeth and the position of the incisal edges, incisal plane, occlusal plane, and gingival margins were evaluated by means of photographs and films within the Digital Smile Design (DSD)^{24,25} protocol. The patient and clinician defined some personalized anatomical characteristics in accordance with the principles of Visagism.²⁶ The team and the patient decided that to attain the best esthetic results, it would be necessary to perform esthetic crown lengthening. The DSD helped with the design of new restorations, assisted in the treatment presentation, and guided the diagnostic wax-up (Fig 2). From this wax-up, the silicone indexes were fabricated in order to construct the APT with bis-acrylic resin (Luxatemp,



Fig 1 Pretreatment situation. Patient complained about the color and size of the teeth as well as incisal embrasures that were too open.



Fig 2 Diagnostic wax-up amending the morphologic problems detected. The teeth were enlarged in all three dimensions.



Fig 3 Testing the design in the mouth with the mock-up using a silicone index and a bis-acrylic type of resin.

DMG; Fig 3). In some cases these mock-ups may not be exactly the same as the diagnostic wax-up due to the hydraulic pressure of placing the silicone guide loaded with resin material, so careful placement is recommended. The APT functioned as a test drive, being fully evaluated by the patient and team, and was accompanied by photographs and video. All the modifications and adjustments were carried out at this stage in order to obtain the best possible result in regard to esthetic design, phonetics, and occlusion. After approval by the patient, an impression of the adjusted mock-up was taken and served as a personalized reference for the final work. From this point onward, the preparation procedures, performed through the APT, were carried out with diamond burs with predetermined depths (directly related to the thickness of the porcelain

Table 1 Calculation of the quantity of dental preparation (in mm) required for the present clinical case

Region	Extra volume (EV) obtained with the mock-up	Laminate thickness (LT)	Quantity of dental preparation (P) to attain color change (A2 to A1)
Cervical third	0.1 to 0.3	0.3	0 to 0.2
Middle third	0.4	0.3	0
Incisal third	0.6	0.5	0
Interproximal area	0.1 to 0.3	0.5	0.2 to 0.4
Incisal edge	1	1 to 1.5	0 to 0.5

laminate veneers), similar to those of the first generation but with the difference of being performed on a precise guide instead of directly on the dental structure. Working in this way, one frequently finds that the preparation does not even touch the tooth enamel, depending on the final dental volume.

The mathematical operation ($EV - LT = P$) was performed for four regions of the tooth: the cervical,

middle, and incisal thirds and the interproximal area. Based on this calculation, the enamel of the middle and the incisal third remained untouched (Table 1 and Fig 4).

The preparation was initiated through the APT on the mock-up by making incisal grooves (Fig 5) with tapered or cylindrical diamond burs of known diameter. There were three grooves that varied in depth according to the previous

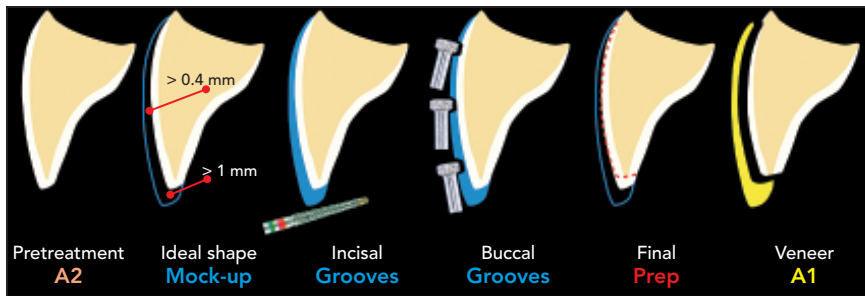


Fig 4 Preservation of the enamel using the mock-up and mathematically calculated preparation to attain the desired color.



Fig 5 First step of tooth preparation: creating the incisal grooves.



Fig 6 Second step of tooth preparation: buccal grooves.

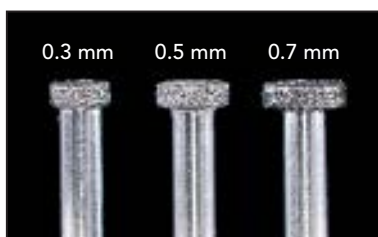


Fig 7 (left) Single-ringed burs allow buccal grooves with different depths to be made in the cervical, middle, and incisal thirds.



Fig 8 Final tooth preparation after determining the cervical, lingual, and interproximal finishing lines. The retraction cords were placed under the microscope to facilitate finishing of the margins.

planning by the dentist and dental technician with regard to the need for incisal stratification. Generally this reduction varies between 1 and 1.5 mm in order to allow the dental technician to re-create an incisal edge with natural characteristics.

Preparation of the buccal surface was directly related to the amount of color change needed. In this case the color change was small, from A2 to A1, and the depth needed by the technician to create this change was between 0.2 and 0.5 mm (Fig 6). This preparation began with grooves that were made with single-ringed burs with thicknesses of 0.3, 0.5, and 0.7 mm for greater control of the quantity of preparation (Fig 7). Three buccal grooves were made, varying in depth according to previous planning. Union of the grooves was made through the APT.^{1,21} After the preparation depths were completed, the APT was removed for the final detailed preparation of the finishing lines in the cervical and interproximal areas (Fig 8).

Extremely delicate laminates of lithium disilicate (IPS e.max, Ivoclar) in the desired color were fabricated, preserving the dental structure and providing excellent clinical results (Figs 9 to 11).

Discussion

A combination of the intraoral mock-up and the mathematical parameters allowed more predictable results because it took into consideration the initial and final color desired for the tooth by calculating

the required thickness of the ceramic system selected to achieve this color. Some ceramic systems, such as IPS e.max, already present a guide for the selection of ingots depending on the initial color of the tooth and the final color of the laminate. However, this guide still does not take into consideration the thickness of the dental preparation. Therefore, it is imperative to have effective communication between the dentist and ceramist during planning of the preparation.^{24,25} The dentist must inform the technician, by means of good-quality photographs, what the actual color of the tooth is and what the desired color is. Together, the dentist and technician must decide the thickness required in order to modify the color and obtain favorable esthetics with the ceramic system of choice.

A change of one or two tones in the shade tabs is generally possible to obtain with a thin laminate (0.3-mm thickness). However, changes of three or more tones require a more invasive preparation. The advantage of applying mathematics associated with the technique of preparation on the mock-up is the precision of the quantity of enamel preparation. This prevents the dentist from overpreparing the tooth in order to avoid making an error in color or preparing the tooth insufficiently and not attaining the desired color. Many cases of teeth with severe color alterations may benefit from additive diagnostic waxing and be conservatively reduced.²¹ On the other hand, as a limitation of this



Fig 9 Final ultrathin ceramic veneers. Buccal thickness around 0.3 mm.



Fig 10 Final outcome on the day of cementation.



Fig 11 Integrated relationship between the teeth and lips.

technique, additive mock-ups may not be effective for malformed or malpositioned and crowded teeth that need to be reoriented prosthetically. In such instances, orthodontic tooth movements may minimize tooth preparation, or an initial preparation may be necessary for a good fit of the mock-up over the teeth.

For a significantly dark tooth, the preparation must extend to the intrasulcular area so that the difference in color between the remaining tooth and restorative material

will not be visible. In the same way, for teeth that need to undergo significant changes in contour, as in the case of closing diastemata, the preparation must extend to the intrasulcular area in the interproximal regions.¹

The design of the incisal preparation continues to be a controversial subject in the literature.²⁷ Some authors have found better results with incisal covering,²⁸ while others have not.²⁹ In the majority of cases, reestablishment of dental volume is accompanied by repositioning

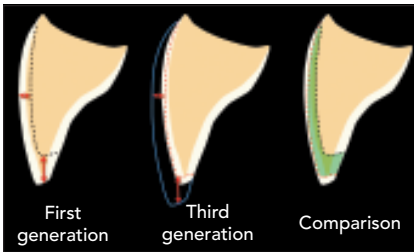


Fig 12 (left) Profile showing the difference from the first- to third-generation methods in terms of incisal reduction.

Fig 13 Patient exhibiting short clinical crowns and diastemata.



Fig 13a Pretreatment intraoral view.



Fig 13b Additive wax-up after esthetic crown lengthening surgery.



Fig 13c Conservative tooth preparation.



Fig 13d Feldspathic laminate veneers from canine to canine.

of the incisal edges in the incisal direction up to the point that esthetics and function allow, so that in many instances no additional tooth reduction occurs in this area. In the third-generation method, an increase in the incisal edge on the mock-up leads to a more conservative preparation (Fig 12).

The strength of the ceramic laminates must also be considered for an adequate preparation.^{10,11} Different materials with particular characteristics may be indicated. Among those most used, feldspathic ceramics have less flexural strength; however, they are more versatile in terms of stratification in layers and thicknesses (Figs 13a to 13d). The lithium disilicate ceramics have greater flexural strength and may be machined, pressed, and receive stratified ceramic coverings. Both materials may be successfully used, provided that the dental technician masters the characteristics of each material.

Conclusions

Ideal color and shape with ceramic laminate veneer restorations can be consistently achieved with the least amount of tooth reduction, as presented in this case study. Tooth preparation through the mock-up, performed according to clinical mathematic parameters, allows greater predictability and excellent esthetic results with ceramic veneers. The authors consider the presented technique to provide decisive parameters about the exact depths of the preparations

because it indicates the quantity and location of tooth reduction required to attain the desired final color with the material selected by the dentist and dental technician.

Acknowledgments

The authors reported no conflicts of interest related to this study.

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