Use of Additive Waxup and Direct Intraoral Mock-up for Enamel Preservation with Porcelain Laminate Veneers

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Abstract

Erosion and surface wear result in the progressive thinning of enamel, ultimately generating increased crown flexibility and higher enamel surface strains. The restoration of tooth volume through the use of bonded porcelain veneers not only reestablishes the original and youthful appearance of the smile, but also allows biomimetic recovery of the crown. The driving force of this process should be the preservation of the remaining enamel. Traditional approaches to veneer preparation can lead to major dentin exposures. Enamel preservation can still be achieved with bonded porcelain veneer restorations, however, given a proper approach to tooth preparation. This article describes a treatment rationale that includes the use of a diagnostic template. This technique, presented here in a clinical case with moderate enamel loss, integrates an additive waxup and a direct intraoral acrylic mock-up. Using this strategy, clinicians should be able to perform tooth preparations that are both more accurate and also higher in quality in an extremely time-efficient fashion compared with traditional methods.
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Fig 1 Preoperative views of patient's face **(a)** and smile **(b)**. The patient is specifically requesting fuller teeth and recovery of the original enamel thickness and incisal length.

In most cases of esthetic rehabilitation, the treatment objective must be reached by means of a diagnostic effort. The latter may consist of a two-step approach including, first, the creation of a diagnostic waxup and, second, the fabrication of a corresponding template to be evaluated in vivo by the patient, usually in the form of a provisional restoration. When porcelain veneers are to be placed, two simple but essential tools—the additive diagnostic waxup and the acrylic mock-up—are indicated during diagnostic steps and tooth preparation procedures for the optimal restoration of the eroded and worn dentition.

Diagnostic waxup and acrylic mock-up

Micrometric measurements of tooth layer thickness for maxillary central incisors show that facial enamel thickness decreases with age.[1] In fact, the recommended uniform enamel reduction of 0.5 mm for porcelain laminate veneer restorations is generally not available in the existing cervical enamel, particularly in older patients. Therefore, when a significant amount of enamel is initially missing because of a history of wear or erosion (Figs 1 and 2), the planned restoration should aim to restore the *original* tooth volume, rather than the *existing* tooth volume. This in turn will provide an adequate tooth prominence and biomimetic behavior of the crown[2]; moreover, it will allow significant retention of enamel substrate and supporting dentinoenamel junction during tooth preparation. This definition of final tooth volume is an essential component of achieving enamel preservation during tooth preparation.

A preliminary restorative goal is obtained primarily by the addition of wax to the preliminary model (Fig 3). This procedure requires a precise knowledge of the strategic elements of tooth anatomy, but also intuition, sensitivity, and a good perception of the patient's individual personality, which usually requires a direct relationship between the patient and the dental technician.[3] A silicon index of an additive waxup is the ultimate tool to be used as a reference for tooth reduction. Prior to tooth

preparation, the additive tooth volume must be approved by the patient, and their complete agreement must be obtained regarding the final tooth shape, size, and length.

In traditional prosthodontics (full crown coverage), preliminary tooth preparation usually precedes the fabrication of the diagnostic template, which is the provisional restoration itself. Such treatment planning is not possible with porcelain veneers; because of the reduced thickness of the laminate and intrinsically conservative approach, the tooth preparation is determined directly by the final volume of the restoration. The in vivo evaluation and full approval of the template by the patient should, therefore, precede tooth preparation procedures.

The simplest method is to fabricate an acrylic template directly in the patient's mouth using self-curing dentin-like polymethyl-methacrylate resin (PMMA; eg, New Outline Dentin, Anaxdent) molded on the unprepared tooth surfaces with a silicon matrix of the waxup (Fig 4). It is highly recommended that a silicon matrix material with a Shore A hardness of 80 to 85 (eg, Platinum 85, Zhermack) be used, which will facilitate handling and intraoral repositioning. For optimal stability in the mouth, the silicon matrix should overlap two teeth on each side of the modified segment. The acrylic mask is uniform in color but provides good insight to the possible esthetic and functional outcome of the restoration.

Fig 2 Preliminary intraoral view showing significant loss of enamel. Existing class 5 composite restorations are covering cervical dentin exposures.

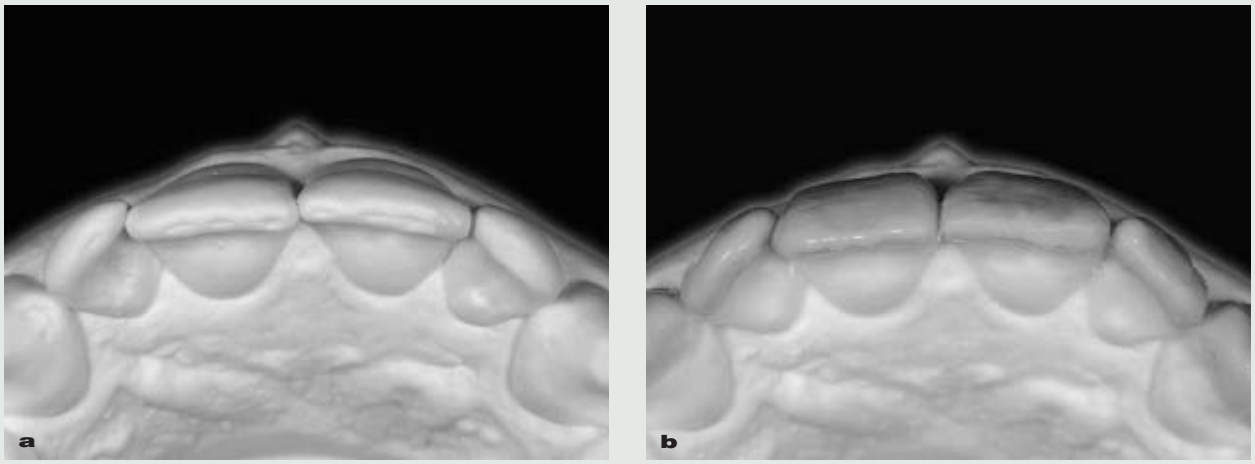

Fig 3 **(a)** Incisal view of preliminary stone cast. Note the thin incisal edge as a result of enamel loss. **(b)** Comparative view of the additive waxup.

It is recommended that the color saturation of interdental spaces be increased using brownish light-curing stains (see Fig 4c) to provide visual separation of the teeth. The final luster can be obtained by glazing with an ultra-low viscosity resin (eg, Skin Glaze, Anaxdent), preliminary light curing (to fix the glaze), and complementary curing through a layer of glycerin jelly to avoid the inhibition layer at the surface of the glaze.

Subsequently, the acrylic mock-up is used by the patient for several days or weeks to evaluate whether the planned restorative treatment will be compatible with the individual's personality, face, smile, oral functions, and subjective expectations. To allow a comfortable trial of the mock-up, it is recommended that the template be bonded by enamel spot etching. This can be achieved by etching a portion of the enamel before applying the resin to the teeth.[4] Conformity with the lower lip contour is of paramount importance in the esthetic evaluation (see Fig 4d), but speech and occlusal comfort are also addressed during this test phase. The mock-up should not be modified before it has been assessed by the patient for at least 1 to 2 weeks, which is the usual time required for a patient to be deprogrammed from the existing situation.

Under some specific circumstances when it is desirable to retract teeth or reduce the original tooth volume (eg, when tooth position is being corrected), preliminary corrections of the crown shape are required to allow the complete seating of the silicon index and subsequent fabrication of the mock-up.[5]

The actual tooth preparation will only be performed after the patient's formal approval of the mock-up.

Simplified tooth preparation technique

Recommended thicknesses for porcelain veneers are less than 0.5 mm in the cervical area, 0.7 mm in the middle and incisal thirds, and greater than 1.5 mm incisal coverage.[6–11] Accurate achievement of such dimensions constitutes the most difficult aspect of tissue reduction because these ultimate thicknesses are intimately related to

Fig 4 **(a)** Clinical situation just after removal of the silicon index used to mold the PMMA resin to the intact teeth. Before the application of the silicon index to the teeth, palatal tooth surfaces and facial gingiva have been isolated with petroleum jelly. Facial enamel has been etched with H_3PO_4 for a few seconds to secure retention of the mock-up. **(b)** The excess resin should be paper thin and easily trimmed with a bur or with a no. 11 blade. **(c)** Light-curing stains and a glazing resin have been used to provide the mock-up a more natural appearance. **(d)** There is an immediate effect on the expression of the smile within the face of the patient, who fully approved the mock-up.

the final volume and shape of the restoration. However, because the diagnostic approach described above is part of this new simplified technique, this goal can be easily attained[4]: The tooth segment provisionally restored by the adhesive mock-up and approved by the patient is now prepared using round calibration diamonds guided by the acrylic template itself (Fig 5).

Facial reduction is initiated using round diamond burs. With the first bur, the difference between the diameter of the bur and the diameter of the shaft should be roughly 1.2 to 1.4 mm, ultimately leading to a cut 0.6 to 0.7 mm in depth when the shaft is placed against the incisal third of the facial surface (see Fig 5a). With the second bur, the difference between the diameter of the

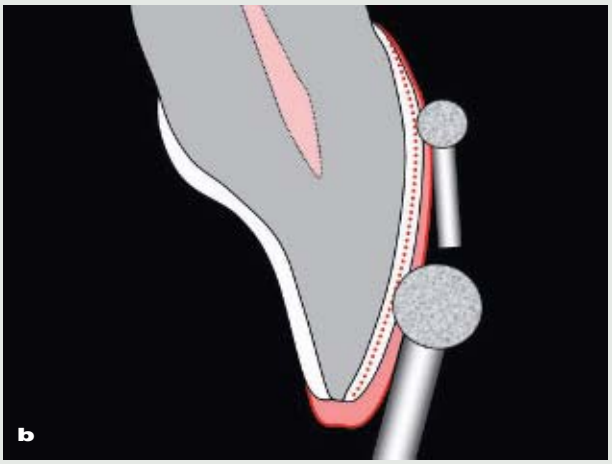

Fig 5 **(a)** Simple round diamond burs represent ideal depth cutters (eg, 801-023, Brasseler). The shank of the bur must always stay in contact with mock-up. **(b)** Use of differential depth cutters (eg, 801-023 and 801-018, Brasseler) in combination with an additive mock-up *(solid red line)* should maintain most of the enamel *(dotted red line)*. **(c)** The large round bur (801-023) is used to create a horizontal groove at the junction between the middle and incisal thirds of the facial surfaces. The small round bur (801-018) is used to create a slightly scalloped groove at the junction between middle and cervical thirds of the facial surfaces. **(d)** Both grooves are then marked with pencil; remnants of acrylic resin from the mock-up can be eliminated with a scaler. **(e and f)** Note the shallow calibration marks. **(g)** Traditional burs (round-ended, slightly tapered) are used for the removal of excess tooth substance between the calibration marks; sufficient space for the porcelain is automatically created when the pencil marks disappear. **(h)** A horizontally sectioned silicon index from the waxup is used to check the facial clearance. **(i)** Clinical view after incisal preparation and finishing steps, including slight proximal separation with ultrathin diamond disks (Vision Flex, Brasseler) to enhance margin definition.

Fig 6 Final intraoral view **(a)** and portrait **(b)** after placement of the porcelain veneers. This final work is a faithful reproduction of the predicted outcome represented by the mock-up and approved by the patient.

bur and the diameter of the shaft is roughly 0.8 to 1.0 mm, ultimately leading to a cut 0.4 to 0.5 mm in depth when the shaft is placed against the middle third of the facial surface. Reduction grooves are marked with a pencil, and traditional chamfer burs are used along the long tooth axis until the pencil marks have been completely removed. Control of initial tissue reduction is improved because the bur stands at a right angle to the initial reduction grooves. All other steps are done according to the traditional approach: A horizontally sectioned silicon index is recommended for confirming the available space, and a palatal index is used to assess the 1.5-mm incisal clearance.

Finishing procedures initially include a slight proximal separation to enhance proximal margin definition during impression and to facilitate subsequent fabrication of stone dies during laboratory procedures. All transition line angles are finally rounded with flexible disks at low speed. A last but essential step before taking final impressions is the immediate sealing of dentin,[12–15] ie, the identification of possible dentin exposures and subsequent sealing of these areas with a dentin adhesive.

Conclusion

The present report illustrates the latest development in tooth preparation for porcelain laminates; using the appropriate diagnostic steps (additive waxup and direct intraoral mock-up) and the new simplified laminate porcelain preparation, clinicians should be able to produce not only more accurate but also higher-quality tooth preparations in a truly time-efficient fashion.

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