

# A Simplified Approach for Restoration of Worn Dentition Using the Full Mock-up Concept: Clinical Case Reports



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*Treatment of tooth wear has increased over the last two decades. However, the treatments involved have not been satisfactory to most patients, nor have they achieved the expected goal on some worn teeth. New approaches have emerged to reconstruct full arches in a minimally invasive way that take advantage of developments in the field of adhesive dentistry. These new concepts constitute a revolution in dentistry and their application requires adapted techniques and training. The purpose of this article is to suggest a precise and reproducible method that simplifies the treatment of worn dentition. A wax-up and a mock-up are primarily used to design the esthetic outcome and then used as a guide for the preparation of anterior teeth or the occlusal surfaces of posterior teeth. This not only provides the exact new vertical dimension of occlusion but serves as a guide for precisely controlling occlusal preparation simultaneously with buccal preparation. The classical cavity design for a partial bonded restoration on posterior worn dentition is also reviewed. The authors believe that during the preparation of the occlusal surfaces of the posterior teeth surfaces, the marginal ridges must be preserved to reduce the biologic cost and mechanical stress leading to fracture. A new type of thin and reduced restoration called tabletop is presented.*

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In esthetic and functional treatments, the final result should be visualized as early as possible when planning treatment and visualization should be continued throughout treatment. This approach ensures that all parties involved with the case have the same endpoint in mind and allows changes prior to cementation of the final restorations. The first step in this visualization process is the diagnostic wax-up created on the models mounted with the new centric relation. This wax-up should be highly indicative of the final result, and it is important to verify that it corresponds to the outcome expected by the dentist and the patient.

The purpose of raising the occlusal vertical dimension (OVD) is to reconstruct the occlusal morphology on worn dentition with the most minimally invasive tooth preparation possible and to restore the smile line with an adequate thickness of the restorative material.<sup>1–3</sup> This will give the clinician and technician more freedom to recreate occlusal harmony, improve the bite, and reduce stress on the muscles, and creates a sufficient interocclusal space to restore proper anterior guidance and correct the occlusal anatomy.

Increasing the OVD is safe and well tolerated by healthy patients.<sup>4,5</sup> In most cases, it would be impossible to recreate the ideal morphology and obtain optimal esthetic results



**Fig 1** (above) *The patient's smile. Note the erosion on the incisal edge.*



**Fig 2** (left) *Intraoral view of the maxillary arch.*

with minimal preparation without changing the OVD. This step is crucial to creating the ideal esthetic and functional project. In other words, the required space for anatomical reconstruction will dictate the new OVD recorded on the patient, giving the lab technician all the information needed to create the new design.

Four clinical steps will be linked to four appointments to propose a standardized treatment that is repeatable and predictable.

## Materials and Methods

### *Step 1: Creating an Esthetic And Functional Treatment Plan*

Facial analysis, photography, alginate impressions, and recording of the new OVD are illustrated in Figs 1 to 4.

When a full-mouth esthetic and functional reconstruction is planned

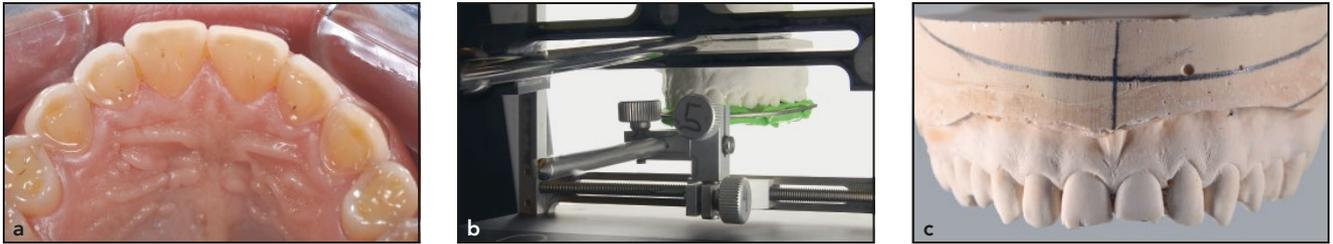
that involves the anterior and posterior teeth, the patient's smile should be carefully observed (face, profile, and dynamic). The use of photographs and video will allow the dentist to analyze the patient's esthetic needs. Ideally, a direct three-dimensional freehand composite should be created over the anterior teeth to establish these esthetic needs (ie, incisal edge position, length). During these procedures, the two most important landmarks of the face (the interpupillary line and the median axis) have to be transferred to the initial working model. Ditrax is appropriate for such a transfer.<sup>6,7</sup> The purpose of such a device is to record and draw face references in an accurate manner on the model (Figs 3b and 3c).

Just as the freehand composite was placed on the facial surfaces of the maxillary incisors, which will be decisive in setting the new incisal edge, a direct composite mock-up

should be placed on the eroded palatal surfaces of the two maxillary central incisors. These composite increments have been placed on the palatal surfaces and will help the dentist guide the patient into centric relation by keeping the posterior teeth separated, which will dictate the new OVD and registration. Centric relation will guide the lab technician in creating the new wax-up over the palatal surfaces of the maxillary incisors and all the posterior teeth, which have been affected by attrition and have erosive surfaces.

The necessary adjustments and corrections should be made and the new OVD registered in centric relation. The increase in OVD is directly related to the space needed to recreate the original anatomy dictated by the thickness of the palatal mock-up of the two maxillary central incisors.

The data needed by the lab has five key elements: (1) a static and



**Fig 3** (a) The palatal surfaces were worn. Most of the palatal enamel was removed by combined abrasion and erosion. (b) Appropriate markers are drawn on the recorded face references using the Ditramax record. (c) Model with horizontal and vertical face references marked.

**Fig 4** Creation of the ideal palatal anatomy with freehand composite followed by corrections and recording of the new OVD at the centric relation.



**Fig 5** (a) Esthetic wax-up to redesign the smile according to the facial analysis. (b) Esthetic and functional wax-up in the space created by the increase in the OVD.

dynamic picture of the face, a picture of the smile, and an intraoral view; (2) an impression of the initial situation; (3) an impression of the initial project made directly in the mouth; (4) face references recorded with Ditramax; and (5) bite registration of the tested and validated new OVD in centric relation.

#### *Step 2: Testing the New Wax-Up with the New OVD*

The maxillary mock-up should be placed first for esthetic priority, buccally and palatally over the anterior teeth (up to the premolars) and occlusally over the premolars and molars.

Next, the mandibular mock-up should be placed. If every step is done properly (ie, wax-up, first mock-up, centric relationship recording), a perfect occlusion will be established between the arches in centric relation (Figs 5 to 7).

The new OVD has to be validated prior to any tooth preparation. If



**Fig 6** Full esthetic mock-up made with Bis-acryl resin (Luxatemp Star, DMG).



**Fig 7** (a) Functional mock-up. The new palatal anatomy can now be visualized to recreate appropriate guidance. (b) Functional mock-up in the posterior maxillary and mandibular arch.



**Fig 8** Posterior prep through the mock-up with 0.5-mm depth cutter.



**Fig 9** After the prepared mock-up is removed, all attention is dedicated to the design with preservation of marginal ridges. The tabletop will be seated on the entire occlusal anatomy, which will allow a minimum thickness of 0.5 mm.

the increase is < 5 mm in the anterior area, it is not necessary to let the patient adapt to the new occlusion for weeks or months<sup>4,5</sup> because the patient accepts it as soon as precise occlusion is achieved. In such cases, the maxillary arch can be prepared at the same appointment, immedi-

ately after the mock-up is tested.

If the increase in the OVD is > 5 mm in the anterior area, it is highly recommended to let the patient approve the esthetic and functional integrations until complete clinical silence, as it may create some reversible pain or discomfort.<sup>5</sup> The chal-

lenge during this phase is to keep the mock-up in place. To enhance retention of the posterior mock-up, the occlusal surfaces of the teeth were covered with a high-viscosity filled adhesive (OptiBond FL, Kerr) before placement of the mock-up. It is important to note the wear pattern on the incisal edges of the teeth, which are very thin and can be chipped during removal of the mock-up.

### Simultaneous Anterior and Posterior Tooth Preparation for Maxillary Mock-up

A sandwich approach (one buccal veneer and one palatal veneer)<sup>8</sup> should be planned for the incisors, canines, and premolars to preserve as much tooth structure as possible. Controlled tooth reduction using the mock-up has to be performed on the anterior and posterior teeth to simplify the preparation and allow minimally invasive preparation of the teeth. Preparing worn teeth for the tabletop design requires a new approach. The additive mock-up and reconstruction already creates a space between the existing tooth form and final volume of the overlays. The mandibular mock-up is used as an antagonist to produce maxillary restorations with an adequate occlusal plan.

### Posterior Preparations for Tabletop Preparation

All preparations of the maxillary arch are made during the same appointment. Posterior preparations for tabletop<sup>9-14</sup> are made prior to the anterior preparations to maintain the OVD with the anterior stops (Figs 8 and 9).

### Anterior Preparations

After post preparation, the OVD is recorded in the posterior area using a bite silicone (LuxaBite, DMG). Anterior preparations follow this step on the buccal and palatal part, and the anterior bite is registered using two-bite silicone after the posterior teeth are prepared at the exact OVD when taking the anterior relationships of the mock-ups as a reference. The bite silicone is injected into the anterior area and connected to the two posterior records.

An impression of the maxillary prepared teeth is made using silicone impression material (Honigum Light Fast and Mixtar Putty Fast, DMG). An alginate impression of the mandibular mock-up is also made and will be the antagonist of the final maxillary restoration.

The current guidelines for preparing buccal veneers at the anterior zone are well known<sup>15-20</sup>; a mock-up is used as a guide for tooth reduction (Figs 10 and 11).

A depth-cutter bur (868A 314 021, Komet) that corresponds to the exact thickness of the porcelain laminate veneer to be constructed, which directly depends on the color changes and material of choice, should be used for controlled penetration through the mock-up to ensure the required space for the final restoration (Figs 10 and 11). This will limit unnecessary reduction of healthy tooth tissue.<sup>20,21</sup> This technique was developed in the early 2000s as a new approach for ceramic veneers and has had a great success rate. The enamel preservation increases the long-term predictability of the restorations.<sup>15</sup>



**Fig 10** According to Gurel's technique in the anterior zone, it is possible to control the depth of the preparation easily, quickly, and precisely.



**Fig 11** Final view of minimal buccal preparations. In this case, the preparations on the margins were made only to stabilize the positioning of the restorations.

### Temporization

If the posterior destruction is severe, an adhesive layer should be applied and lightly cured on the prepared surface prior to placement of the full mock-up (used here as a temporary instead of for visualization and guidance). If the posterior destruction is not severe and occlusal enamel is present, temporization will be focused on the eight facial anterior teeth because it will be almost impossible to maintain the thin posterior temporaries.

### Fabrication of the Restorations

Tabletop restorations were made with lithium disilicate (IPS e.max

Press HT, Ivoclar Vivadent), buccal laminates with the same material but different translucency (IPS e.max Press LT, Ivoclar Vivadent), and palatal laminate with lab composite (Nexco Ivoclar Vivadent) to preserve the untreated mandibular incisors as much as possible (Figs 12 and 13).

### Step 3: Cementation of the Maxillary Restoration and Preparation of the Mandibular Arch

Cementation should be carried out under the control of a rubber dam, one tooth at a time. This individual



**Fig 12** Palatal view of the central incisors. Note the lack of prep for palatal veneers. Preparation was achieved with a round bur limited to stabilizing the veneers. For the premolars, the sandwich concept (two pieces) was applied.



**Fig 13** View of thin tabletop (IPS e.max Press HT) and buccal laminate (IPS e.max Press LT) preparations after finalization and before cementation. The tabletop preparations are just pressed and stained, which allows good homogeneity and an ideal mimic effect.

dam technique<sup>11-13</sup> has been used in the Restorative Department in Marseille for the last 20 years (Figs 14 to 17).

The advantages of improved visibility, instrument access, and moisture control far outweigh the disadvantage of a longer procedure time. Furthermore, the individual dam protects the patient from inhaling the toxic aluminum oxide (30 to 50  $\mu\text{m}$ ) used for sandblasting the tooth (Dento-Prep, Rønvig; Aqua-Care, Velopex) to eliminate the adhesive layer<sup>13,22</sup> used for the temporary restorations. The tooth surface is then

etched (37% phosphoric acid, 30 seconds). Primer and adhesive (All-Bond ACE, Bisco) are applied (repeated twice to optimize the interface) and the surface dried and light-cured for 1 minute (2,000  $\text{mW}/\text{cm}^2$ ; Bluephase 20i, Ivoclar Vivadent).

The restorations are cemented in place with a light-cured veneer luting resin cement (Variolink Esthetic, Ivoclar Vivadent; HRi flow Dentin A1, Micerium) (Fig 15).

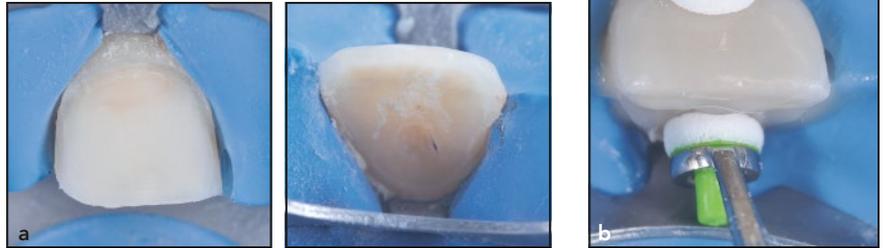
During the same appointment, just after the maxillary restorations are bonded, the mandibular mock-up is placed again (no posterior

temporaries are used) in the mouth. The occlusion is controlled and the OVD checked. Some occlusal corrections are needed but will be done from the mandibular mock-up instead of the final restorations on the maxillary arch.

#### Mandibular Preparation

Controlled preparation through the mock-up is performed following the same protocol as described for the maxillary arch. All marginal ridges are preserved to place the restoration on top of the entire occlusal anatomy (Figs 18 and 19).

**Fig 14** Individual dam placement before cementation. (a) Sandwich technique in the anterior area. (b) One palatal veneer and one buccal veneer were placed simultaneously.



**Fig 15** Comparison of the buccal anatomy before and after restoration.



**Fig 16** Mimeticism of lithium disilicate due to the translucency of the HT ingot.



**Fig 17** Occlusal view of the sandwich restorations and specially bonded palatal laminate veneers.

**Fig 18** Final view of minimal occlusal preparations. Note the preserved proximal ridges from the noninvasive method, which was used for mechanical and biologic reasons.



**Fig 19** Preparation design in the mandibular posterior area.



**Fig 20** Bonding procedure for the tabletop preparation. (a) Sandblasting (AquaCare, Velopex). (b) Total etch, 30 seconds (Uni-Etch 37%, Bisco). (c) Universal adhesive (All-Bond ACE Universal, Bisco). (d) Cementation with application of the Optrasculpt PAD (Ivoclar Vivadent) to press the restoration after the removal of excess luting resin to achieve the ideal fit of the restoration (Variolink Esthetic, Ivoclar Vivadent). (e) Final view after removal of the excess.

#### Step 4: Cementation of the Mandibular Arch Restoration if Needed

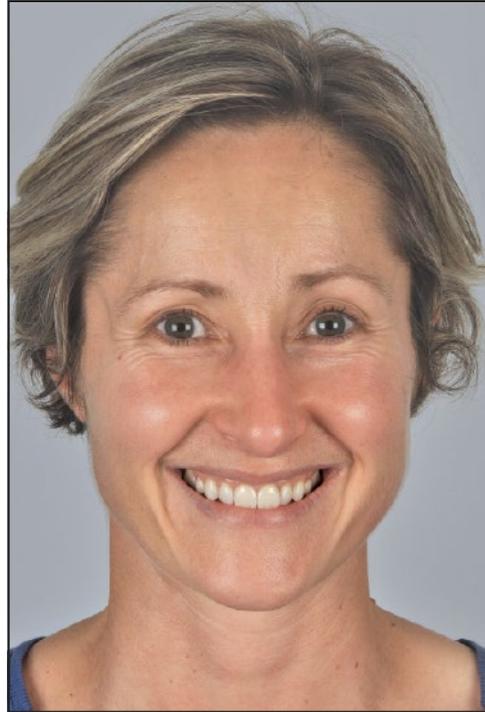
Both arches are included in treatment planning. Cementation of the mandibular arch is shown in Fig 20.

#### Checking the Final Occlusion

The occlusion is checked in static and dynamic positions to ensure functional integration of the restoration. Occlusal tabletops require mechanical polishing of the margins with low roughness burs and silicone

polishing burs. Together with precision in marginal fit, this technique will ensure excellent marginal integrity and a healthy tissue response. On completing the cementation, a successful result is achieved when both the clinician and patient are satisfied.

**Fig 21** (below) *Integration of the laminate veneer (ceramist: Gerald Ubassy, Rochefort du Gard, France).*



**Fig 22** *New smile, new eyes.*

The restoration-luting resin-tooth complex becomes a biomimetic restoration (Figs 21 and 22).

#### Maintenance and Protection

A thin occlusal guard (1 mm) is provided to the patient after the treatment to protect the restorations against clenching, grinding, or para-functional activities during sleep.

#### Discussion

One concept and many techniques have been proposed to treat worn dentition over the last 8 years. The concept is increasing the OVD, mostly for biologic reasons but also to allow occlusal harmony. Different

clinical solutions are proposed to the dentist, such as full monolithic crown,<sup>23</sup> veneer with a sandwich technique and direct composite in the posterior area or tabletop preparation,<sup>24–26</sup> or a full-mouth composite rehabilitation.<sup>27,28</sup> All of these techniques are scientific and represent a contemporary clinical approach but may require a certain skill or be dependent on the practitioner. The full mock-up concept is presented here as a simple technique based on pre-visualization validated esthetically and functionally by the patient and then used as an accurate guide (via preparation through the mock-up for anterior teeth and the posterior occlusal surfaces of the teeth). Four appointments are needed. The aim

of this clinical approach is to match the treatment of worn dentition with everyday practice.

#### Conclusions

In today's world of bonding, tissue preservation is critical,<sup>29,30</sup> and clinicians often forget or bypass the strict rules of minimally invasive tooth preparation techniques and designs for fixed prostheses because of technical challenges, time constraints, or lack of training. Treating dental wear in younger patients is also an important challenge for clinicians. However, patients can be treated with a very low biologic cost due to the performance of

current materials. The difficult balance between biology, esthetics, and function can be achieved. The goal of this minimalistic approach is to simplify the procedures for clinicians and provide strict guidelines to make the treatment feasible, repeatable, and predictable.

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