



Full-Mouth Adhesive Rehabilitation of a Severely Eroded Dentition: The Three-Step Technique. Part 1.

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Abstract

Traditionally, a full-mouth rehabilitation based on full-crown coverage has been the recommended treatment for patients affected by severe dental erosion. Nowadays, thanks to improved adhesive techniques, the indications for crowns have decreased and a more conservative approach may be proposed.

Even though adhesive treatments simplify both the clinical and laboratory procedures, restoring such patients still remains a challenge due to the great amount of tooth destruction. To facilitate the clinician's task during the planning and execution of a full-mouth adhesive rehabilitation, an innovative concept has been developed: the three-step technique. Three laboratory steps are alternated with three

clinical steps, allowing the clinician and the laboratory technician to constantly interact to achieve the most predictable esthetic and functional outcome. During the first step, an esthetic evaluation is performed to establish the position of the plane of occlusion. In the second step, the patient's posterior quadrants are restored at an increased vertical dimension. Finally, the third step reestablishes the anterior guidance. Using the three-step technique, the clinician can transform a full-mouth rehabilitation into a rehabilitation for individual quadrants. This article illustrates only the first step in detail, explaining all the clinical parameters that should be analyzed before initiating treatment.

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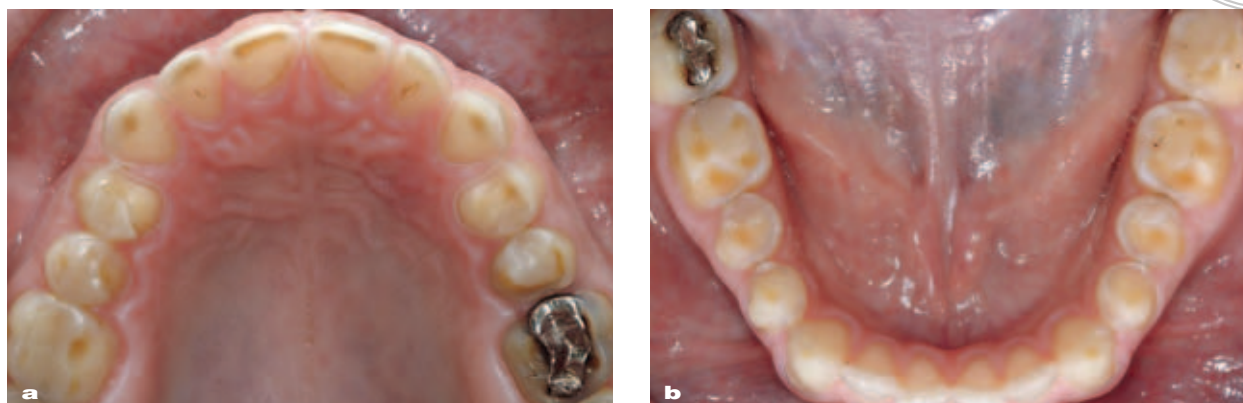


Fig 1 (a and b) Severely eroded dentition in a 27-year-old patient.

Patients affected by severe dental erosion often present with an extremely damaged dentition, especially in the anterior maxillary quadrant. The vertical dimension of occlusion (VDO) may have decreased, and supraeruption may have occurred. If erosion is not intercepted at an early stage, full-mouth rehabilitation may be required. According to the available literature (case reports only), the recommended therapy comprises both extensive elective root canal treatment and full-crown coverage of almost all teeth.¹⁻³ However, this approach

may be too aggressive considering that the population affected by erosion is generally very young (Fig 1).

When a 14-year-old patient receives a full-mouth conventional rehabilitation, such as in a recently published report,² the following questions should be considered: How many times will these crowns have to be replaced in the future, and what will be the prognosis of such teeth? How many of the teeth will remain vital? How many will become nonrestorable (Fig 2)?



Fig 2 Panoramic radiograph of a 70-year-old patient with a heavily restored dentition. The patient received his first full-mouth rehabilitation at the age of 50.

The current literature does not answer these questions. No long-term follow-up studies of similar cases are available. Consequently, before proposing conventional full-mouth rehabilitation to young individuals affected by erosion, clinicians should consider more conservative approaches. In this context, improved adhesive techniques may be a valid alternative, at least to postpone more invasive treatments until the patient is older.⁴⁻⁷

The adhesive approach preserves more tooth structure and avoids elective endodontic therapy. In addition, in the authors' opinion, the esthetic outcome of teeth restored with bonded porcelain restorations is superior to that achieved with cemented crown restorations. Further, gingiva seems to interact better with the margins of bonded veneers than with the margins of cemented crowns, resulting in less inflammation or dark colorations.

However, while several authors have documented long-term follow-up for conventional fixed prostheses,⁸⁻¹⁷ there is a lack of comparable long-term data on full-

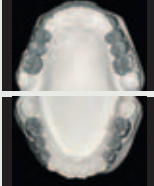
mouth adhesive restorations. Consequently, the debate is still open on whether a possibly less durable adhesive rehabilitation is preferable to longer-lasting but more aggressive conventional treatment.

For this reason, a clinical trial is underway at the University of Geneva. All patients affected by generalized erosion are systematically and exclusively treated with adhesive techniques, using onlays for the posterior region and bonded laminate veneers for the anterior region. The goal is to evaluate the longevity of adhesive rehabilitations before proposing this treatment as the new standard of care.

The three-step technique

To achieve maximum preservation of tooth structure and the most predictable esthetic and functional outcomes, an innovative concept has been developed: the three-step technique (Table 1). Three laboratory steps are alternated with three clinical steps, allowing the clinician and dental

Table 1 The three-step technique

Laboratory			Clinical	
	Maxillary vestibular waxup	Step 1: Esthetics	Assessment of occlusal plane	
	Posterior occlusal waxup	Step 2: Posterior support	Creation of posterior occlusion at an increased VDO	
	Maxillary anterior palatal onlays	Step 3: Anterior guidance	Reestablishment of final anterior guidance	



technician to constantly interact during the planning and execution of a full-mouth adhesive rehabilitation.

In the first laboratory step, instead of a full-mouth waxup, the technician is instructed to wax up only the vestibular aspect of the maxillary teeth (esthetically driven wax-up). Afterwards, the clinician will check if the waxup is clinically correct using a maxillary vestibular mockup (first clinical step).

During the second laboratory step, the technician focuses on the posterior quadrants, creating a posterior occlusal waxup to determine a new VDO. The second clinical step is to give the patient a stable occlusion in the posterior quadrants at an increased VDO, closely reproducing the occlusal scheme of the waxup. With the use of silicon keys duplicating the waxup, all four posterior quadrants will be restored with provisional posterior composites.

Finally, the third step deals with the reconstruction of the palatal aspect of the maxillary anterior teeth (restoration of the anterior guidance) before restoring the vestibular aspect with bonded porcelain restorations.

In this article, only the first step is discussed.

Treatment planning

Unrealistic patient expectations are often a contraindication to dental treatment. However, what seems to be an unrealistic expectation may in fact be a poorly expressed expectation or an expectation that is misunderstood by the clinician. Even when there is seemingly perfect three-way communication (patient/clinician/technician), there is always potential for misunderstandings, especially when dealing with patients who are accustomed to viewing themselves with small, eroded teeth.

The importance of a predictable result that satisfies both the patient and clinician cannot be stressed enough in today's world of esthetically demanding patients. Surprisingly, many clinicians still decide on the esthetic outcome for their patients, and thus the result seldom meets the patient's expectations. A structured strategy to minimize such an esthetic "defeat" is to devote sufficient time to educate patients about the treatment options and expected results. The first step of this three-step technique is conceived to guarantee that the clinician and technician's vision for the planned restoration is a reflection of the patient's true desires.

Step 1: Maxillary vestibular waxup and assessment of the occlusal plane

Generally, at the beginning of a full-mouth rehabilitation, the clinician will provide the laboratory technician with the diagnostic casts and request a full-mouth waxup. Since each parameter, such as incisal edges, teeth axes, teeth shapes and sizes, occlusal plane, etc, is easily controlled, waxing both the maxillary and mandibular arches is not a difficult task.

Clinicians should realize, however, that laboratory technicians will often arbitrarily decide on these parameters without seeing the patients and with a misleading lack of reference points (eg, adjacent intact teeth). Unfortunately, a decision based only on diagnostic casts is extremely risky, since a dental restoration that appears perfect on the cast may be clinically inadequate.

One method to ensure that everyone is on the same page is the use of a mockup, a technique that makes it possible to anticipate the final shape of the teeth in the mouth. Several authors have already



Fig 3 Frontal (**a**) and profile (**b**) views of a 45-year-old patient affected by gastric reflux. Note the severe generalized tooth destruction as a result of the dental erosion.



Fig 4 Both a traditional mockup (covering only the maxillary anterior teeth) (**a and b**) and a maxillary vestibular mock-up (from second premolar to second premolar) (**c and d**) were used to evaluate esthetics. With the traditional mockup, the anterior teeth appeared too long, and the patient disliked their length and shape. Once the mockup was extended to the premolars, the patient rated the same anterior teeth as esthetically pleasing.

proposed the use of a mockup for veneer restorations of anterior teeth.^{18,19} In cases of severe generalized destruction of the dentition, a mockup of only the anterior teeth could be misleading, since the teeth will appear inharmonic with the unre-

stored posterior teeth. Instead, a mockup that involves all maxillary teeth may be a more appropriate approach (Figs 3 to 5). To obtain a mockup of all maxillary teeth is not necessary at this initial stage to have a full mouth wax-up. In fact, the three-step



Fig 5 Facial views before **(a)** and after **(b and c)** the maxillary vestibular mockup.

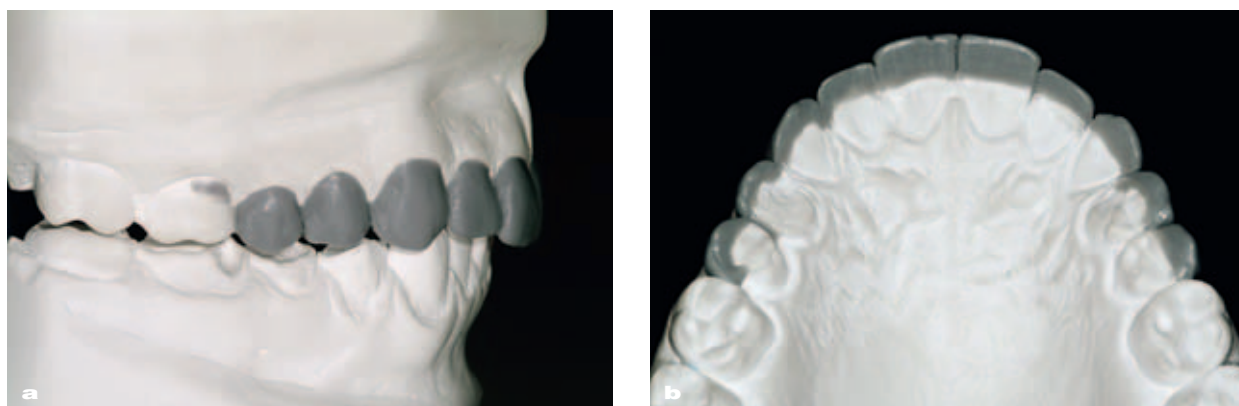


Fig 6 (a and b) Maxillary vestibular wax-up. Note that the cingula and the palatal cusps are not included. In this patient, the vestibular aspects of both the first maxillary molars were intact and thus not included in the waxup.

technique proposes that the technician should wax up only the vestibular surface of the maxillary teeth. To save time and facilitate the next clinical step, neither the cingula of the anterior maxilla nor the palatal cusps of the maxillary posterior teeth are included.

In situations where the vestibular aspect of the first molars was not affected by the erosion, the technician may stop the waxup at the level of the premolars (Fig 6). The maxillary second molar is never included in the waxup. At the completion of the max-

illary vestibular waxup, the first clinical step (maxillary vestibular mockup) is introduced so that the clinician can confirm the direction taken by the technician. The factors that should be considered during this assessment will now be discussed.

Incisal edges

Patients are often shocked by the increased length of the incisors selected by the clinician and technician. After years of seeing themselves with a compromised dentition, many patients cannot immedi-



Fig 7 (a to c) When an increased VDO is planned, the position of the occlusal plane is decided arbitrarily by the technician. Often, the obtained space is shared equally between the two arches, with a consequent change of position of the occlusal plane (lower position). This arbitrary decision can compromise the esthetic outcome in patients with a preexisting “reverse” smile.

ately adapt to more voluminous teeth. Often, patients will eventually agree to such a change if they are allowed to test the new teeth; however, some patients will never accept it. Clinicians cannot impose their personal opinions onto their patients, but they can try to guide the patient in making an informed decision.

The mockup represents an excellent opportunity for patients and clinicians to truly understand each other's points of view. The mockup covering the teeth can be shortened or lengthened (using flowable composite), and their shape can be modified. If major changes are made, an alginate impression can be taken to guide the technician.

Occlusal plane

The innovative aspect of the three-step technique is the extension of the mockup to the vestibular aspect of the maxillary posterior teeth. The inclusion of the four premolars is crucial, not only to visualize their buccal aspect in comparison with the anterior teeth (vestibular harmony), but also to relate the plane of occlusion to the incisal edges. Maxillary incisal edges and the occlusal plane should be in harmony for an optimal esthetic and functional result.

In a frontal, smiling view, the cusps of the posterior teeth should follow the lower lip and be located more cervically than the incisal edges. Otherwise, an unpleasant, “reverse” smile is generated.

When an increase of the VDO is anticipated in a full-mouth rehabilitation, the question of how to divide the extra interocclusal space is generally answered by sharing the space equally between the mandibular and maxillary arches. However, such a decision is completely arbitrary and may lead to a repositioning of the occlusal plane at a lower level than the original.

Unfortunately, in cases of erosion, the loss of tooth structure is often compensated for by supraeruption, especially in the maxillary posterior region and mandibular anterior region. One goal of a full-mouth rehabilitation should be the correction of such a situation. The technician must know to what extent the incisal edges can be lengthened before deciding on the occlusal plane's position and waxing up the posterior quadrants. A maxillary vestibular mockup, which visualizes both the incisal edges and the buccal cusps of the posterior teeth, can help verify the orientation of the future occlusal plane (Figs 7 and 8).



Fig 8 (a to f) Before and after views of a 27-year-old patient with a history of gastric acid reflux. The mockup reestablished the harmony between the occlusal and incisal planes.

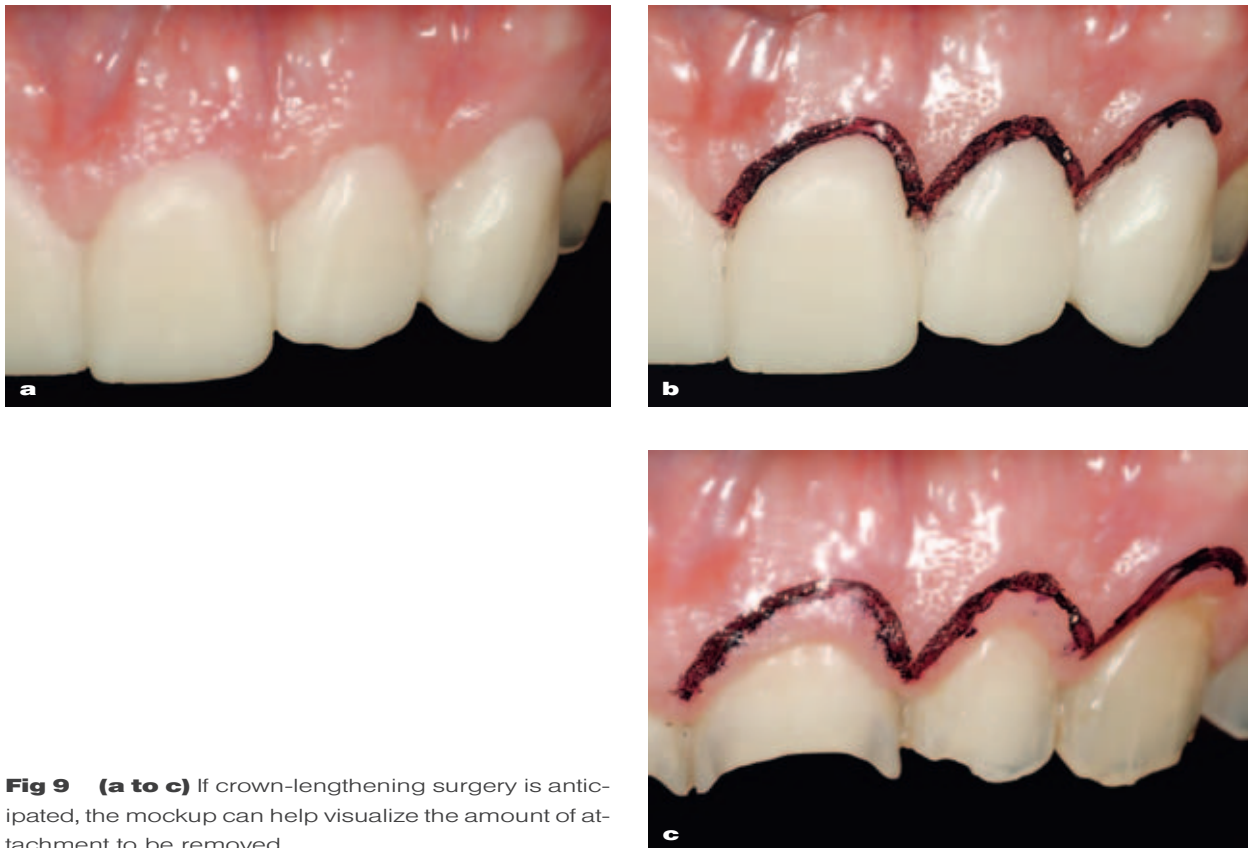


Fig 9 (a to c) If crown-lengthening surgery is anticipated, the mockup can help visualize the amount of attachment to be removed.

Harmony with the maxillary molars

If the waxup is stopped at the level of the maxillary premolars, it will be possible during the maxillary vestibular mockup to evaluate how the unrestored molars will blend in with the restoration planned for the premolars. The lip display will also preview the visibility of the buccal margins of the future restorations (onlays) for the molars.

Emergence profile and gingival levels

At the time of the waxup, the clinician and technician can determine whether crown lengthening is needed (Figs 9 and 10). To confirm if mucogingival surgery is necessary and to what extent, the technician should wax the cervical aspect of the future restorations overlapping the gingiva of the cast. Consequently, the teeth of the mock-up will cover the gingiva of the patient. Their emergence profile will be slightly altered, but they will still provide a good sense of the final outcome to both the clinician and the patient.

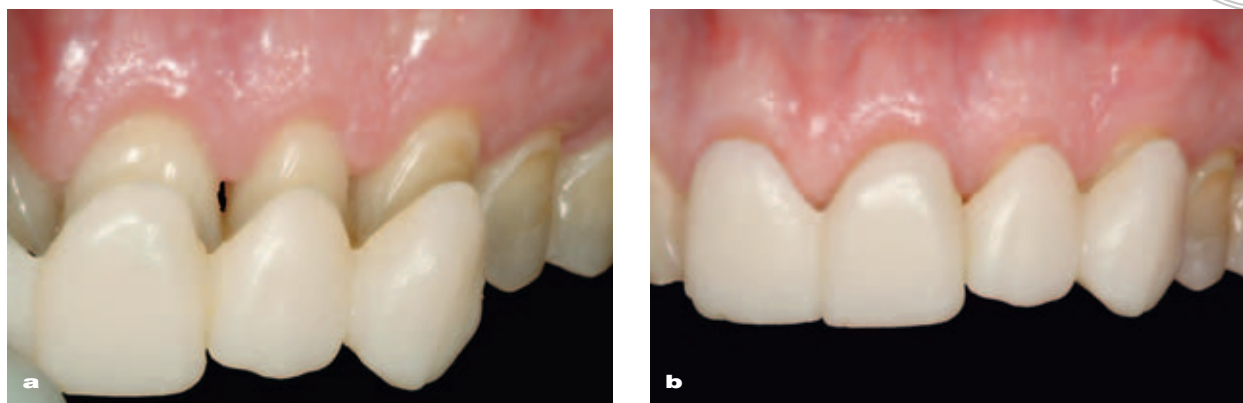


Fig 10 (a and b) After surgery, the mockup can be used to evaluate the outcome.

Based on the lip display, the teeth to be involved in the surgery can be selected, and the patient can make an informed decision whether to accept the surgery. This presurgical mockup can be a powerful tool to convince reluctant patients. In these cases, the compromised result could also be visualized with another mockup, this time without the gingival overlap.

Number of teeth involved in the rehabilitation

Sometimes, patients are not fully aware of the level of destruction of their dentition. Motivated primarily by esthetics, patients may believe that a satisfactory result can be achieved by focusing only on the anterior teeth, and thus they will not be interested in a more comprehensive treatment plan. To avoid investing unnecessary time and money, a maxillary vestibular mockup could be used. The mockup covering the posterior teeth could then be removed, leaving the patient with the mockup of only the six anterior teeth. While some of these patients will still “run away” as anticipated, others will be convinced to accept the more extensive treatment.

Clinical steps for the maxillary vestibular mockup

The maxillary vestibular mockup is quickly and easily fabricated in the patient’s mouth and offers the possibility to concretely visualize the final outcome. A silicon key should be made from the maxillary vestibular wax-up and loaded with a tooth-colored material in the patient’s mouth (Fig 11). After its removal, all vestibular surfaces of the maxillary teeth will be covered by a thin layer of composite, reproducing the shape selected for the future restorations with the wax-up. In our clinic, the material of choice is Protemp (3M ESPE), a resin composite that generates a limited exothermic reaction and is easy to dispense and less subject to porosity than polymethyl metacrylate. Since the cingula of the anterior teeth and the palatal cusps of the posterior teeth are not included in the waxup, the silicon key will be stable in the mouth. It will also be stabilized on both sides by the unrestored second molars (distal stops).

Due to the key’s close adaptation, excess material will be minimal and easy to remove using a scalpel or scaler (Fig 12). It is not recommended to remove and re-

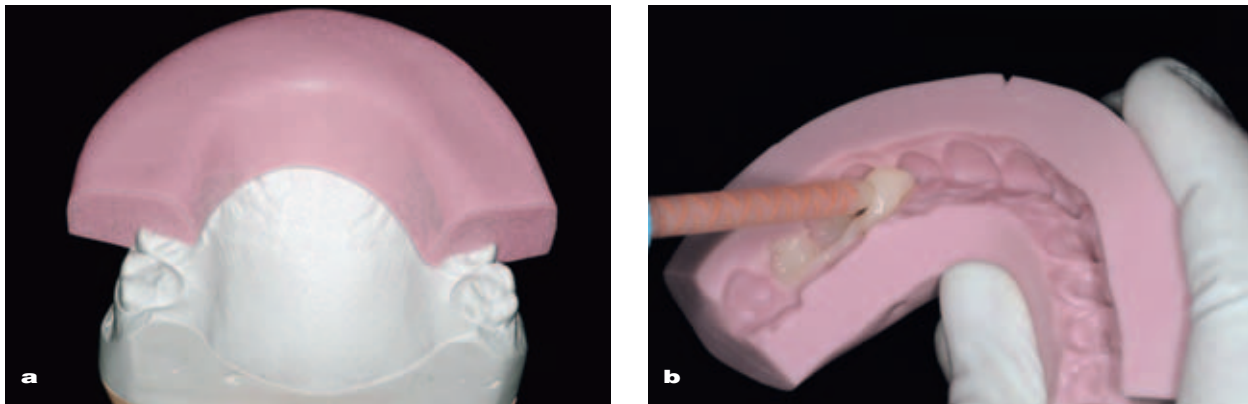


Fig 11 (a and b) A silicone key of the maxillary vestibular waxup is fabricated and loaded with tooth-colored provisional resin composite.



Fig 12 (a to c) Due to the key's close adaptation, very little excess will be present after its removal. Note the shortening of the canines **(c)** The mockup can be easily modified in the patient's mouth.

cement the mockup, because this may break it or distort its appearance. The mockup is stabilized by excess material in

the retentive areas (interproximally). The clinician, however, should pay particular attention to that excess, since it can interfere



Fig 13 (a to f) Before and after views of a 27-year-old female patient. Without the mockup, it was difficult to evaluate her smile, since she was uncomfortable showing her damaged teeth.

with the patient's normal oral hygiene procedures. The challenge is to open the gingival embrasures just enough to allow dental floss (eg, SuperFloss, Oral B) to pass through without jeopardizing the strength of the mockup. It is also recommended to accurately remove the excesses at the level of the buccal gingival sulci to better understand the emergence profile and gingival harmony of the future restoration.

The patient can leave the office wearing the mockup for a short time to show it to family members and friends. Due to its minimal thickness, the mockup will eventually break off, making it easily removable by the patient. After evaluating the maxillary vestibular mockup in the patient's mouth (Fig 13), any changes can be made by the technician, who will then progress with the second laboratory step.

Conclusions

Patients affected by severe dental erosion often present severely damaged dentition. However, the traditional restorative approach (full-mouth rehabilitation with crowns) may be too aggressive for this generally young patient population. In the authors' opinion, an adhesive approach should be preferred to preserve tooth structure and postpone the more invasive treatments until the patient is older.

Even though adhesive techniques simplify both the clinical and laboratory procedures, restoring such a patient still remains a challenge due to the amount of tooth destruction. To achieve maximum preservation of the tooth structure and the most predictable esthetic and functional outcome, an innovative concept has been developed: the three-step technique. The three-

step technique is a simplified approach that emphasizes interdisciplinary collaboration between the clinician and laboratory technician.

In this article, only the first step of the technique was described. By using a simple maxillary vestibular mockup, the laboratory technician can gain precious information, and the treatment of a severely eroded dentition can begin in a less arbitrary way. The time-consuming initial diagnosis should not discourage the clinician, since the patient's full participation in any decision-making process is extremely valuable. Indeed, allowing patients to visualize the final result before treatment begins both reassures them and helps them accept more comprehensive treatments.

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