State-of-the-Art Patient-Centered Treatment & Management of Tooth Wear

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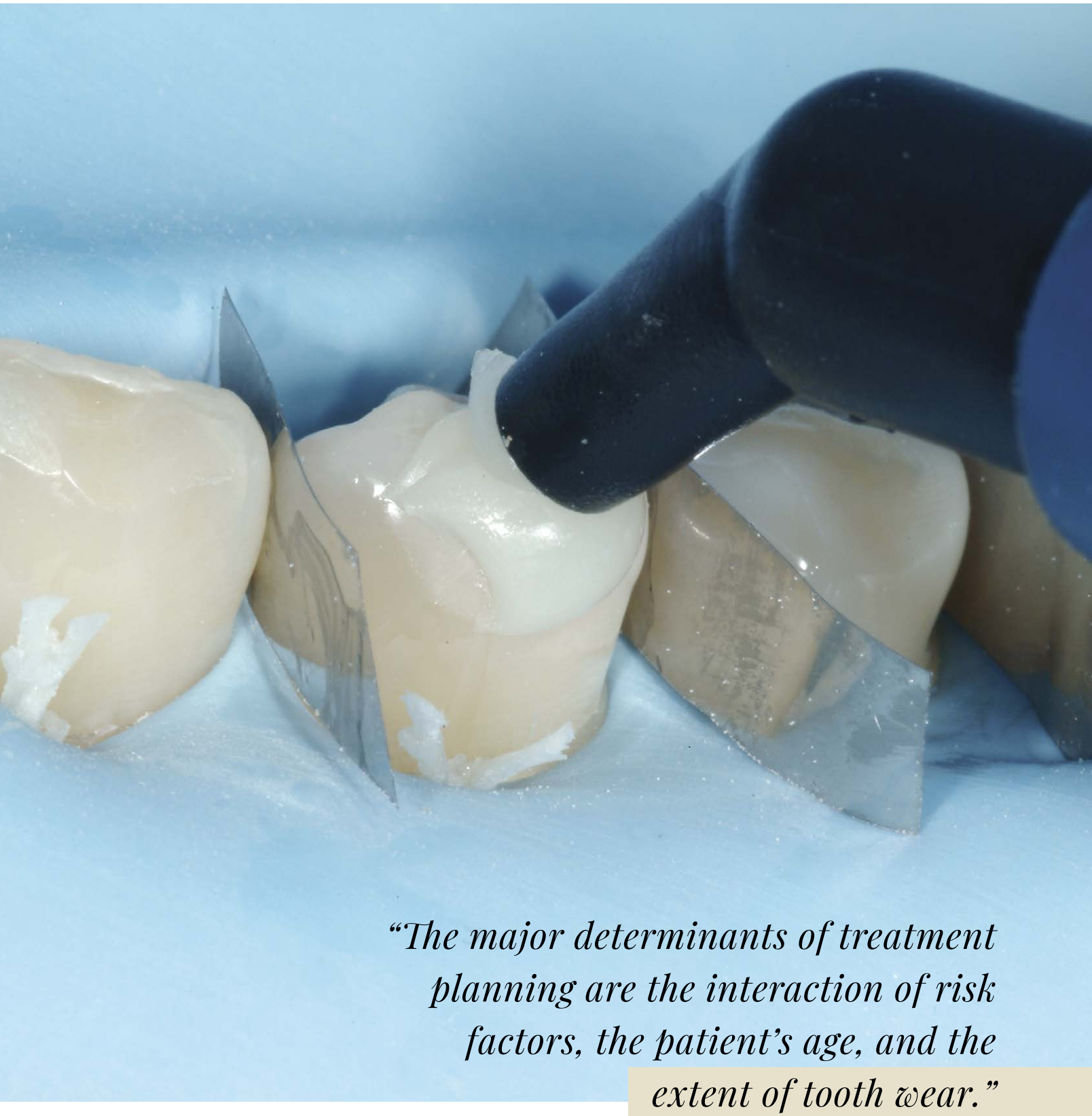
Abstract

Tooth erosion is a common pathology with numerous possible etiologies, including behavioral changes, parafunctions, an imbalanced diet, certain medical disorders, and medications that cause acid reflux or influence saliva composition and flow rate. Because such factors can have severe long-term biological, functional, and esthetic consequences, it has become increasingly important to detect early signs of tooth wear so that appropriate preventive and, if necessary, interceptive-restorative measures can be implemented. Adhesive, ultra-conservative techniques have proven effective, particularly in treating moderate to advanced tooth wear. This article presents a modern approach to managing tooth wear with patient-centered strategies based on recognized biomechanical principles.

Key Words: tooth wear, composite restorations, minimally invasive dentistry, function, VDO change



"The major determinants of treatment planning are the interaction of risk factors, the patient's age, and the extent of tooth wear."

Introduction

There is far from a consensus on how to best manage tooth wear in terms of diagnosis, prevention, and treatment, whether in the short or long term.[1] The use of various terms to describe the same condition or similar terms to explain a different one has added to the confusion, as have differing opinions about the degree or even nature of tooth wear that should be classified as "physiological" or "pathological," possibly leading to insufficient focus on the early signs of "abnormal" erosion and attrition. Given the underutilized preventive measures, the 2020 consensus report on "erosive tooth wear terminology" was particularly welcome as it helped to clarify this issue.[2] When it comes to treatment, we are presented with a wide range of options ranging from undertreatment to overtreatment, with a general trend toward monotherapies, particularly those based on CAD/CAM or indirect approaches. Case reports abound on social media, but these can often be misleading by not considering individual patient biomechanical factors or the variability in the degree of tooth wear between different zones within the same mouth. Academic clinicians and research groups, on the other hand, underline the need to employ conservative strategies.[3,4]

Like any other dental or medical treatment, the treatment for tooth erosion should be based on a sound diagnosis and risk factor analysis that considers the nature of hard tissue loss, its extent, the patient's age, as well as any other relevant pathologies. These factors contribute to a more efficient decision-making process when choosing the most appropriate strategy from among three options: preventive, interceptive, or restorative **(Fig 1)**.

Risk Factors

Mechanical

Tooth wear occurs primarily due to either chemical or mechanical tissue loss.[3,5,6] Mechanical risk factors comprise abrasion due to action from foreign objects (e.g., tooth brushing over cervical dentin), attrition from direct dental contacts, and erosion due to the action of extrinsic or intrinsic acid sources. The most common factors increasing attrition above physiological levels are bruxism and clenching. Gastroesophageal reflux disease (GERD), hiatal hernia, imbalanced diets, and some medications are the most common causes of erosion; less frequent but far more dramatic are the dental consequences of bulimia or anorexia, which both involve frequent, self-induced vomiting. **Figure 2** depicts the most realistic model for tooth wear, implying dynamic evolution and varying contributions of risk factors.

Erosion, attrition, and abrasion: Erosion, attrition, and abrasion (as well as abfraction, a type of coronal enamel loss often due to tooth flexure under strong occlusal forces) result in specific lesion patterns that are clearly identifiable if only one risk factor is present. Single risk factors, however, are uncommon. The more usual scenario of multiple risk factors results in lesions that are less typical in appearance. This situation necessitates a comprehensive initial examination to identify all risk factors, monitor them, and try to control them. Characteristically, erosion causes smoothing of various tooth surfaces (depending on the acid source) and saucer-shaped occlusal lesions, whereas attrition results in wear facets localized at contact points. Wear facets, therefore, are related to the occlusal scheme and types of parafunctions (clenching and/or bruxism with various combinations of central and latero-protrusive movements). Abrasion occurs when the dentin is exposed (e.g., during brushing) or when a foreign object or substance comes into regular contact with teeth.

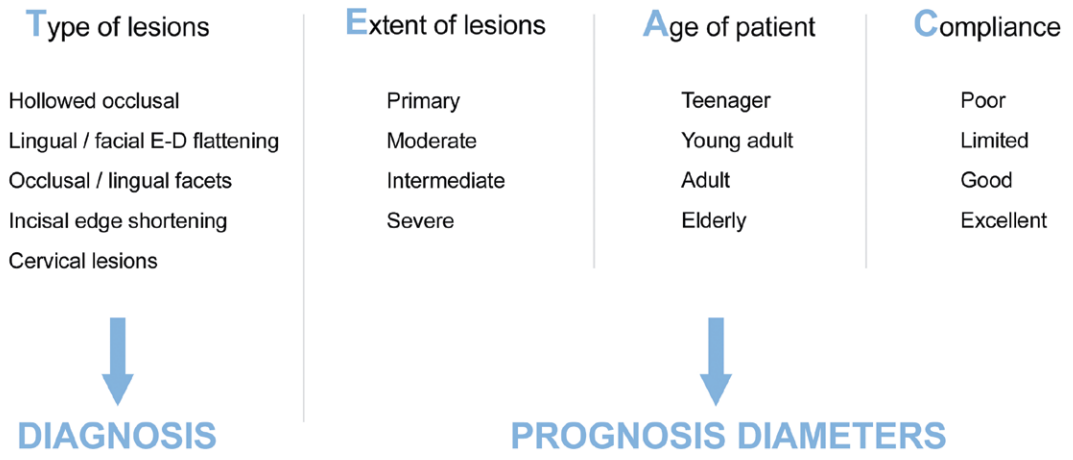


Figure 1: Factors to consider in determining the type and extent of tooth wear lesions. In conjunction with the patient's age and potential or known compliance, these criteria help the clinician choose the most appropriate treatment.

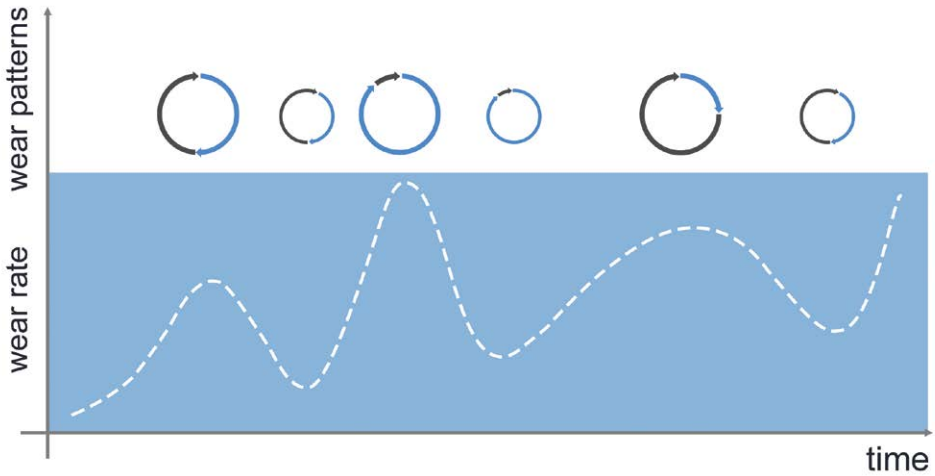


Figure 2: Diagram representing the possible evolution of tooth wear over time, including periods of increased or decreased attrition and erosion, as well as their respective contributions to hard tissue loss. This model should be viewed as more realistic than a continuous progression of tooth wear caused by a single risk factor.

By analyzing tooth wear lesions, it is possible to identify more obvious risk factors and better understand their mechanical implications (for example, erosion and attrition both cause loss of tooth structure, but different occlusal forces likely cause them, which can impact material selection). However, it should be noted that highly imbalanced diets, anorexia, and bulimia are frequently associated with unstable personalities who may be more likely to engage in parafunctional activities. Careful observation of wear lesions and general anamnesis will also guide the clinician toward the most appropriate restorative material based on the restoration's anticipated volume and thickness. The significant determinants of treatment planning are the interaction of risk factors, the patient's age, and the extent of tooth wear.

Treatment Strategies

Preventive

These include an array of measures, based on identified risk factors, to arrest or at least slow the progression of tooth wear. Prevention of erosion involves medical measures to improve a patient's diet, treat GERD, or help bulimic and anorexic patients with pharmaco- and/or psychotherapeutic interventions. A final preventive option is to use buffering, protective varnishes, or remineralizing solutions. To lessen the impact of parafunctions, simple protection with a nightguard is the current approach for moderate sleep bruxism, while botulin injections are considered an alternative for serious bruxism or noncompliant patients.

Interceptive

When tooth wear extends beyond what is considered normal (e.g., dentin is being exposed on numerous teeth in children or young adults), following a solely additive protocol with composite resins is considered the best approach. This interceptive strategy comprises various protocols such as direct freehand, partial molding, or full molding techniques.[7-12]

Restorative

In cases where a preventive strategy has not been successful (often due to patient noncompliance) or in cases where an interceptive strategy appears no longer adequate (e.g., when there is severe erosion and/or attrition), the overall or localized use of indirect restorations—a restorative strategy—may be required. When a restorative strategy is necessary, either CAD/CAM or indirect techniques utilizing bondable monolithic high-strength ceramics are considered optimal options.

The differences among the three strategies mentioned above support a progressive, logical biomechanical approach to tooth wear management with a long-term perspective. Over time, risk factors will likely increase in their severity and implications. Preventive measures should, of course, be implemented taking into account the long term, and, when appropriate, should be combined with interceptive and restorative strategies.

Combined Strategies

Another key strategy is to combine materials and clinical protocols because, as previously noted, tooth wear affects different zones of the mouth to varying degrees. Employing a single technique throughout the entire mouth is not a realistic approach for all patients.[13] Due to the increasing incidence and prevalence of tooth wear, particularly among juvenile and young adult populations at all socioeconomic levels, preventing and arresting tooth wear has become a significant objective in dentistry.[14,15]

Discussion

Interceptive strategies focus on using composite with only an additive application, which can be done freehand or with a molding approach. The latter option comprises the partial molding technique, which allows for the reconstruction of buccal and lingual cusps before applying a final occlusal increment freehand, and the full molding technique,[16] which enables the restoration of an entire sextant in a single "stamp" procedure. Interceptive protocols are intended to treat patients

Figure 3: Retracted view of the patient's smile.

Figures 4a & 4b: Retracted views of the maxillary and mandibular teeth show obvious wear and discoloration.

Figures 5-8: The posterior teeth show moderate wear, primarily due to attrition, with erosion linked to heavy consumption of carbonated beverages.

with moderate tooth wear rather than those who are heavy bruxers or clenchers. The advantage of this approach is that it is highly adaptable to the clinician's level of expertise with direct protocols as well as the extent of tooth wear, as long as the interceptive strategy's indications are met (clinical and laboratory procedures are detailed in the two case presentations that follow). This hybrid strategy is a significant advance in tooth wear management because it eliminates the need to prepare additional teeth, as opposed to the previous belief that all restorations must be made of the same material, which fails to account for the fact that each patient's wear patterns, extent, and etiologies are unique.

Clinical Cases

Case 1: Interceptive and Restorative Strategies for a Full-Mouth Rehabilitation

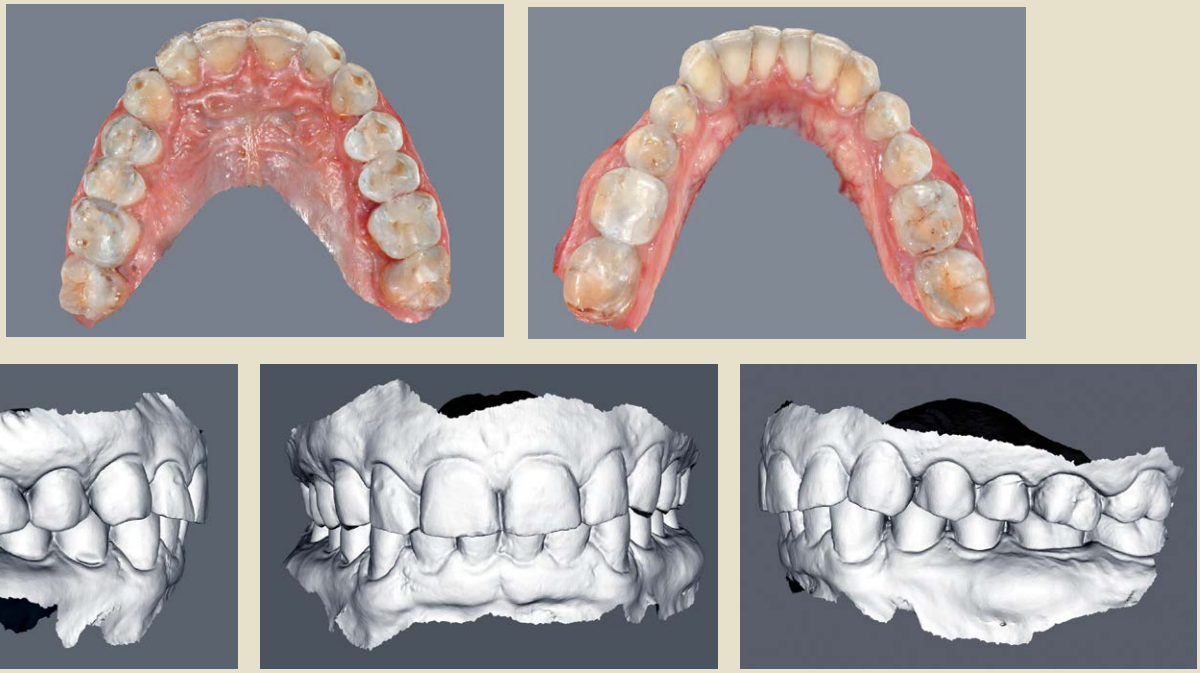
Complaints and findings: The 41-year-old male patient came in for an esthetic consultation; his main concerns were the effects of tooth wear on the appearance of his smile (which included irregular incisal edges and shortened teeth), as well as discolorations **(Figs 3-8)**.[17] He had occasional hypersensitivity but no functional discomfort or temporomandibular joint problems.

The patient's medical history disclosed no contributory illness. Clinical examination revealed moderate, generalized wear due to sleep and awake bruxism, as well as erosion caused by frequent consumption of carbonated beverages. The patient was informed that risk factors needed to be controlled and that a nightguard would be required once the restorations were placed.

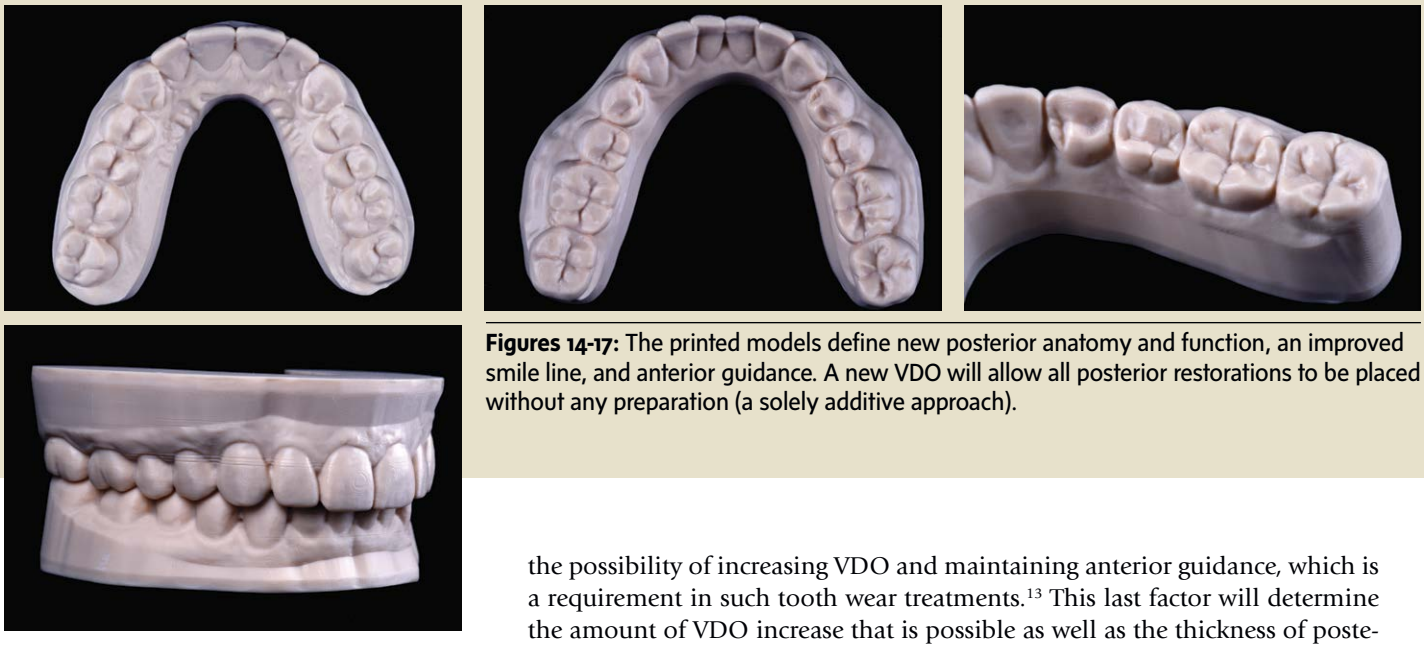
Treatment goals: After receiving the patient's consent for treatment using a hybrid strategy (direct composite restorations for the mandibular teeth and ceramic veneers for the maxillary teeth), digital impressions were made to analyze the case **(Figs 9-17)** and define the treatment goals, which were as follows:

- enhanced smile line/tooth display
- improved anterior guidance
- new vertical dimension of occlusion (VDO)
- proper occlusion.

VDO increase: The decision was made to restore the case in the maximum intercuspation position (MIP), which was nearly identical to the centric relation position (CRP). In a case with a retruded CRP, using this position could limit



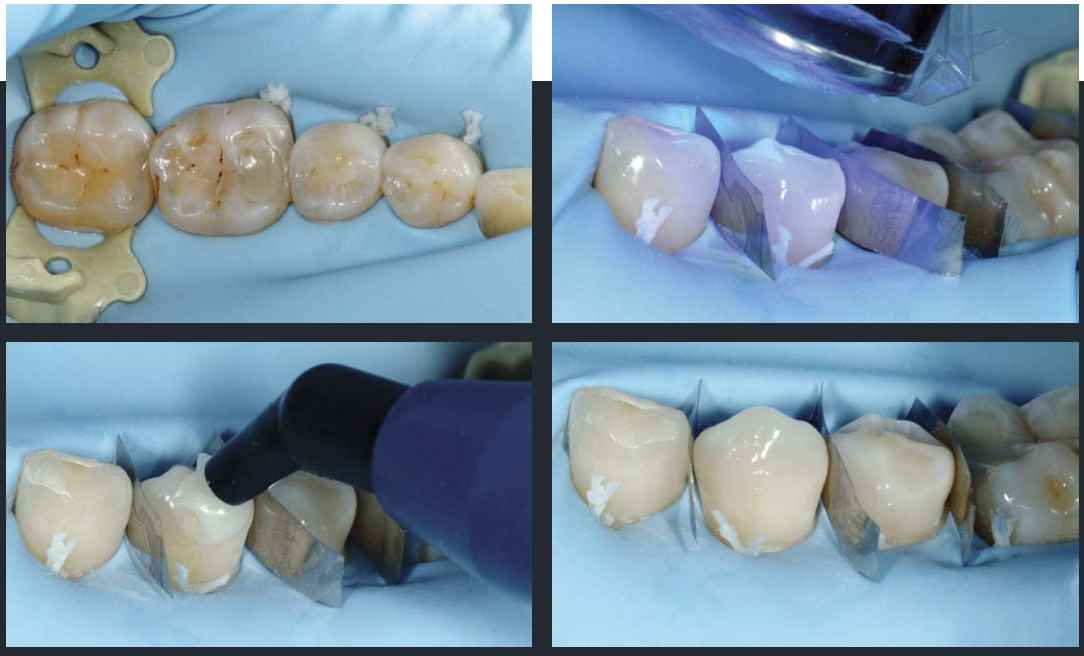
Figures 9-13: Digital impressions were made as an initial occluso-functional analysis and to determine a new VDO and improved anterior guidance and smile.



Figures 14-17: The printed models define new posterior anatomy and function, an improved smile line, and anterior guidance. A new VDO will allow all posterior restorations to be placed without any preparation (a solely additive approach).

the possibility of increasing VDO and maintaining anterior guidance, which is a requirement in such tooth wear treatments.[13] This last factor will determine the amount of VDO increase that is possible as well as the thickness of posterior restorations. VDO increases at the incisor level are usually 3 to 4 mm and are considered completely safe. Thus, no pretreatment testing is necessary.[18,19] In general, CRP should no longer be used as a reference in the rehabilitation of fully dentate patients.[20,21]

Treatment: The direct freehand composite restorations, facilitated by a digital wax-up, were completed in three appointments **(Figs 18-37)**, with another three sessions for the maxillary veneers **(Figs 38-45)**. Impressions for the nightguard were taken at the first posttreatment visit, approximately two weeks after treatment had concluded.



Figures 18-21: Restoring posterior occlusion via a direct freehand approach guided by the digital wax-up. The teeth were sandblasted before applying a multifunction total-etch adhesive (Optibond FL, Kerr; Orange, CA).

Figure 22: After completion of direct buildups in the mandibular left sextant.

Figures 23 & 24: Completed treatment of the lower posterior teeth utilizing no-preparation direct composite restorations.

Figures 25 & 26: Wear lesions (caused by erosion and attrition) are visible, but their moderate extent allowed for a straightforward treatment with a direct composite. The use of an indirect, more extensive, and intrusive restorative approach is not needed for such wear.


Figures 27 & 28: Completed maxillary left and right sextants.




Figures 29-32: The wax-up determined the amount of incisal buildup for the mandibular anterior teeth using a direct restorative system (Skin White, Inspiro, Edelweiss DR; Zug, Switzerland). The new tooth length can be measured with a caliper or calculated with a silicone index.

Tips

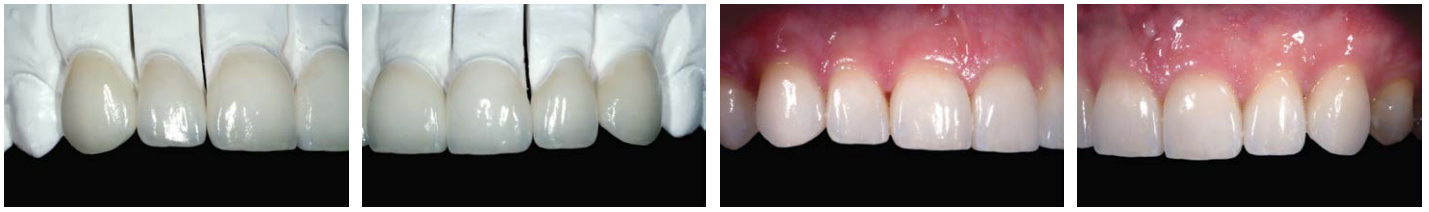
- Preventive measures should always be taken first, as well as accompanying interceptive and restorative therapies; controlling tooth wear risk factors is critical to long-term success.
- A comprehensive treatment plan employing an analog or digital wax-up is necessary to successfully treat tooth wear cases with either interceptive or restorative protocols.
- Treatment planning should begin with anterior function and esthetics, but treatment itself often follows the reverse approach, with the reconstruction of posterior occlusion coming first, followed by the restoration of anterior teeth.

Figure 33: Posttreatment view of the mandibular anterior teeth; note the improved canine height, which will provide better guidance.

Figures 34-37: Completed direct freehand restorations of posterior sextants guided by the wax-up; this improves function and protects worn surfaces from worsening, with all the advantages of a no-preparation technique.

Figure 38: After the first restorative phase, a retracted view of the patient's smile included the new VDO and posterior occlusion achieved with direct composite restorations over the four posterior sextants and mandibular anterior teeth.

Figure 39: Smile view showing the temporaries (veneers) used to evaluate the new tooth display; the patient thought the proposed teeth length was excessive and required slight shortening.



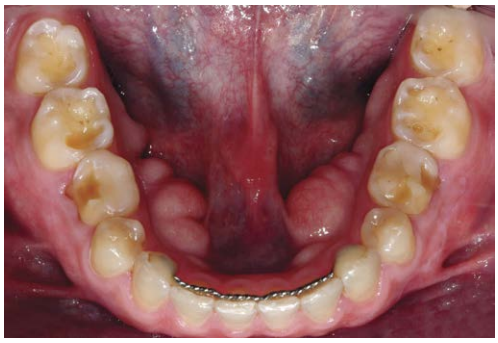
Figures 40-43: Veneers were chosen to restore the patient's maxillary anterior teeth in order to meet his esthetic requirements. They were also a more durable choice for reducing the risk of future incisal edge wear and lowering the likelihood of composite chipping.

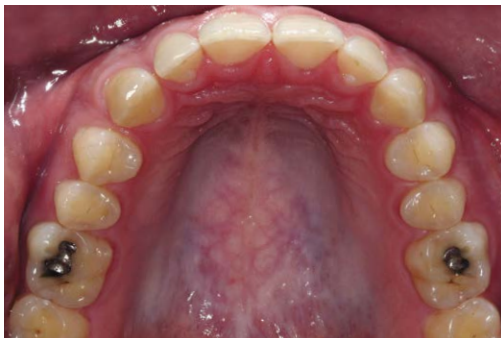
Figures 44 & 45: The completed treatment met the goals of the patient's esthetic needs, tissue conservation, and treatment "simplicity" while minimizing costs. Such treatment allows for greater patient acceptance for treating moderate tooth wear and prevents many cases from worsening due to the higher expense of many indirect full-mouth rehabilitations.

Case 2: Interceptive Treatment and Long-Term Follow-Up

Initial treatment: The patient, a dentist, first consulted the author in 2010 regarding the moderate to severe erosion of his mandibular posterior teeth (there was also slight wear of the mandibular anterior and maxillary posterior dentition, but that would be controlled with simple preventive measures). This overall approach was deemed appropriate due to the localized nature of the tooth wear **(Figs 46-48)**.

The case was restored in MIP. The worn mandibular posterior teeth were treated in two sessions on the same day to allow the patient to leave with a stable occlusion **(Figs 49-60)**. In the second treatment phase, the palatal surfaces of the maxillary anterior teeth were restored directly to compensate for the VDO increase caused by the fully additive technique used for the mandibular posterior teeth **(Fig 61)**. A small amount of composite was also added on the incisal edge of tooth #9 to level-up the existing smile line **(Figs 62 & 63)**. As in Case 1, a direct approach and a wax-up to guide the freehand application of composite were employed.





Figures 46-48: Pretreatment images reveal moderate erosion in the mandibular posterior teeth and minor localized damage in the maxillary arch. Tooth #9 has a shorter incisal edge. Note the presence of second deciduous molars, which exhibited limited root resorption.

Figures 49-53: The restorations were achieved with a bilaminar technique following the Natural Layering Concept:[22] dentin was applied in a single (or a maximum of two) increments while enamel was applied in a single layer and sculpted freehand (Miris2 Dentin S4 and Enamel White, Coltene; Cuyahoga Falls, OH).







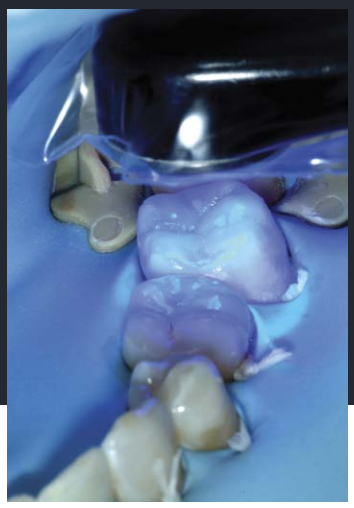
Figures 54-60: The completed direct restorations under rubber dam isolation and during occlusal adjustments. There was a minimal change of occlusal anatomy due to functional equilibration, which provided adequate protection for eroded tissue and proper occlusion.



Figures 61-63: Direct composites were placed on the palatal surfaces of the maxillary anterior teeth to compensate for the VDO increase. Tooth #9's length was corrected at this time.

Long-term follow-up treatment: The patient returned in 2021 for a reevaluation of his case (there had been no intermediate intervention other than preventing further erosion with a nightguard and dietary management to decrease acid consumption). This follow-up after 11 years revealed that the direct composite restorations were performing satisfactorily in a favorable biofunctional environment, with no significant parafunctional activities or erosion. However, slight wear flattened the anatomy and exposed a small amount of dentin in the second molars, necessitating the addition of some composite **(Figs 64-66)**. The author knew from experience that, as long as there was no evident degradation of the internal adhesive interfaces, it was possible to repair the restorations without entirely removing the existing composite. The removal was accomplished by sandblasting the enamel and composite surfaces before applying a multifunctional adhesive (e.g., Optibond FL, or Clearfil SE Bond, Kuraray [New York, NY]) and a wear-resistant, highly filled enamel composite (Skin and Ice, Inspiro) **(Figs 67-72)**. As in 2010, treatment comprised a slight VDO increase, followed by modification of the maxillary anterior palatal surfaces to maintain anterior contacts and guidance **(Figs 73-76)**.

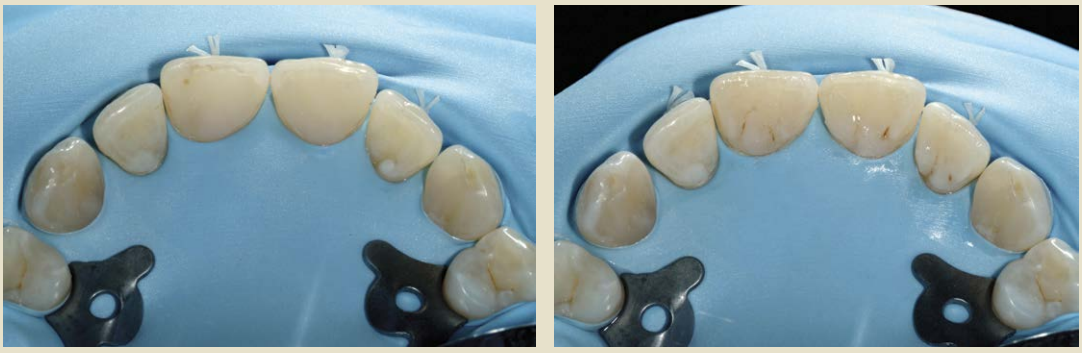
Figures 64-66: Eleven years after treatment, the overall behavior of the mandibular direct composites was highly satisfactory. However, some dentin had become exposed where the restorative material was thin.



Figures 67-70: The repair of restorations placed 11 years earlier comprised sandblasting of composite and enamel surfaces, applying a multifunctional adhesive, and placing new composite to recreate full occlusal contours and function. Surface effect shades completed this simple restorative procedure.

"Employing a single technique throughout the entire mouth is not a realistic approach for all patients."

Figures 71 & 72: The mandibular posterior sextants after treatment.



Figures 73 & 74: The palatal surfaces of the maxillary anterior teeth were modified again to accommodate the new change in VDO caused by the alteration in posterior morphology. Because of the well-known compensating effects generated by increased VDO (neuromuscular adaptation and then intrusion), it is assumed that initial treatment and renewing VDO increases do not simply add to each other.

Figures 75 & 76: Completed renewal of the case, demonstrating the protocol's effectiveness in treating moderate hard tissue loss in the absence of significant erosion or parafunctional risk factors.

Summary

Because tooth wear affects different mouth zones to varying degrees, highly individualized treatment approaches and combined strategies are required. Tooth wear is also an evolving process, and the selected treatment strategy will need to be reevaluated regularly to adapt to the problem's stabilization or progression. The failure to pay attention to progressive tooth wear can lead to serious biomechanical and esthetic complications. Interceptive and restorative procedures aid in the resolution of complex cases and/or specific esthetic or biomechanical requirements, but as their long-term maintenance is significantly more complex and costly, they are generally not recommended for routine cases.

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