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CLINICAL REPORT

Simplified treatment of severe dental erosion with ultrathin CAD-CAM composite occlusal veneers and anterior bilaminar veneers

Luís Henrique Schlichting, DDS, MS, PhD,[a] Tayane Holz Resende, DDS, MS,[b] Kátia Rodrigues Reis, DDS, MS, PhD,[c] and Pascal Magne, DMD, PhD[d]

ABSTRACT

Restorative treatment for patients with dental erosion requires an analysis of the degree of structural damage. Patients affected by moderate to severe dental erosion are particularly challenging because complex occlusal reconstruction will be needed. Ultrathin bonded occlusal veneers represent a conservative alternative to traditional onlays and complete coverage crowns for the treatment of severe erosion. This article describes a complete mouth rehabilitation with ultrathin computer-aided design and computer-aided manufacturing (CAD-CAM) composite resin occlusal veneers in a patient with a severely eroded dentition. In the maxillary anterior teeth, the bilaminar approach was chosen with lingual composite resin veneers and labial porcelain veneers. The main benefit of this approach is the possibility of using additive adhesive techniques, allowing only strategic reduction of sound dental structure or no preparation. (J Prosthet Dent 2016;116:474-482)

Erosive tooth wear is a physiological condition experienced to a certain degree by everyone. Any divergences of the ideal tooth morphology, at each group age, if not due to trauma, caries, or attrition, would call for additional investigation of possible pathological erosive tooth wear.[1] Its diagnosis in the early stages is challenging even for trained clinicians.[2]

Whenever possible, direct composite resins may be used for covering even severe erosive lesions. In patients presenting with deep localized concave lesions (with surrounding enamel ridges), direct composite resins could be the first choice to recover the structural integrity and cover the exposed dentin.[3] However, dentitions with uniform and generalized tissue loss affecting the entire occlusal surface demand more complex solutions. Because of the effect of the vertical dimension of occlusion (VDO), posteruptive movement and alveolar compensation are likely to occur while teeth maintain their occlusal contact, compromising the space for the restorative material in most of the occlusal surface. Sometimes these patients are treated with palliative restorations because of budget limitations or technical decisions.[4] However, traditional approaches will involve invasive, complete mouth rehabilitations involving significant financial and biological costs (sacrifice of intact tissue). For patients where a substantial amount of dental tissue has already been lost by erosion, extensive tooth preparation may be considered inappropriate.[5]

However, during the last decade, these concerns have been addressed with efforts to find alternatives to the aggressiveness of classic preparations and their consequences.[6-8] Development of stronger materials such as lithium disilicate ceramics and high performance composite resins and computer-aided design and computer-aided manufacturing (CAD-CAM) technology[9-14] combined with improved bonding protocols (such as immediate dentin sealing [IDS])[15-17] have paved the way for a new class of restorative design.[5,18] Both scientific evidence and common sense indicate that ultrathin

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[a]Clinical Assistant Professor, Department of General Dentistry, School of Dental Medicine, East Carolina University, Greenville, NC.
[b]Visiting Researcher, Department of Prosthodontics and Dental Materials, School of Dentistry, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil.
[c]Assistant Professor, Department of Prosthodontics and Dental Materials, School of Dentistry, Federal University of Rio de Janeiro, Rio de Janeiro, Brazil.
[d]The Don and Sybil Harrington Professor of Esthetic Dentistry, Restorative Sciences, Ostrow School of Dentistry, University of Southern California, Los Angeles, Calif.

Figure 1. Preoperative view. A, Shy smile displayed by patient to hide eroded teeth. B, Intraoral view in maximum incuspation. C-F, Intraoral occlusal views reveal severe loss of enamel on occlusal surfaces. Maxillary anterior teeth present extensive dentin exposure on the palatal aspect.

CAD-CAM bonded posterior occlusal veneers are a better alternative to traditional onlays and complete coverage crowns for the treatment of severe erosive lesions.[4,5,18-22] Their minimal design,[4] ranging from 0.4- to 0.6-mm thick at the developmental grooves to 1.0- to 1.3-mm at the cusp tip, requires a simpler, more intuitive, and less significant preparation, driven only by interocclusal clearance and anatomic considerations.[5,18] On many occasions, no preparation is needed. Furthermore, their similarities with anterior porcelain laminate veneers allow the translation of the principles applied to those restorations.

CLINICAL REPORT

A 32-year-old man presented as a new patient to the Department of Prosthodontics and Dental Materials at the Federal University of Rio de Janeiro in 2014, requesting treatment for dentin sensitivity and dental wear (Fig. 1A, B). Clinical examination revealed generalized loss of enamel with characteristic signs[23] consistent with severe dental erosion (Fig. 1C-F). All teeth were vital.

The patient's medical history included current gastroenterology treatment for heartburn, globus

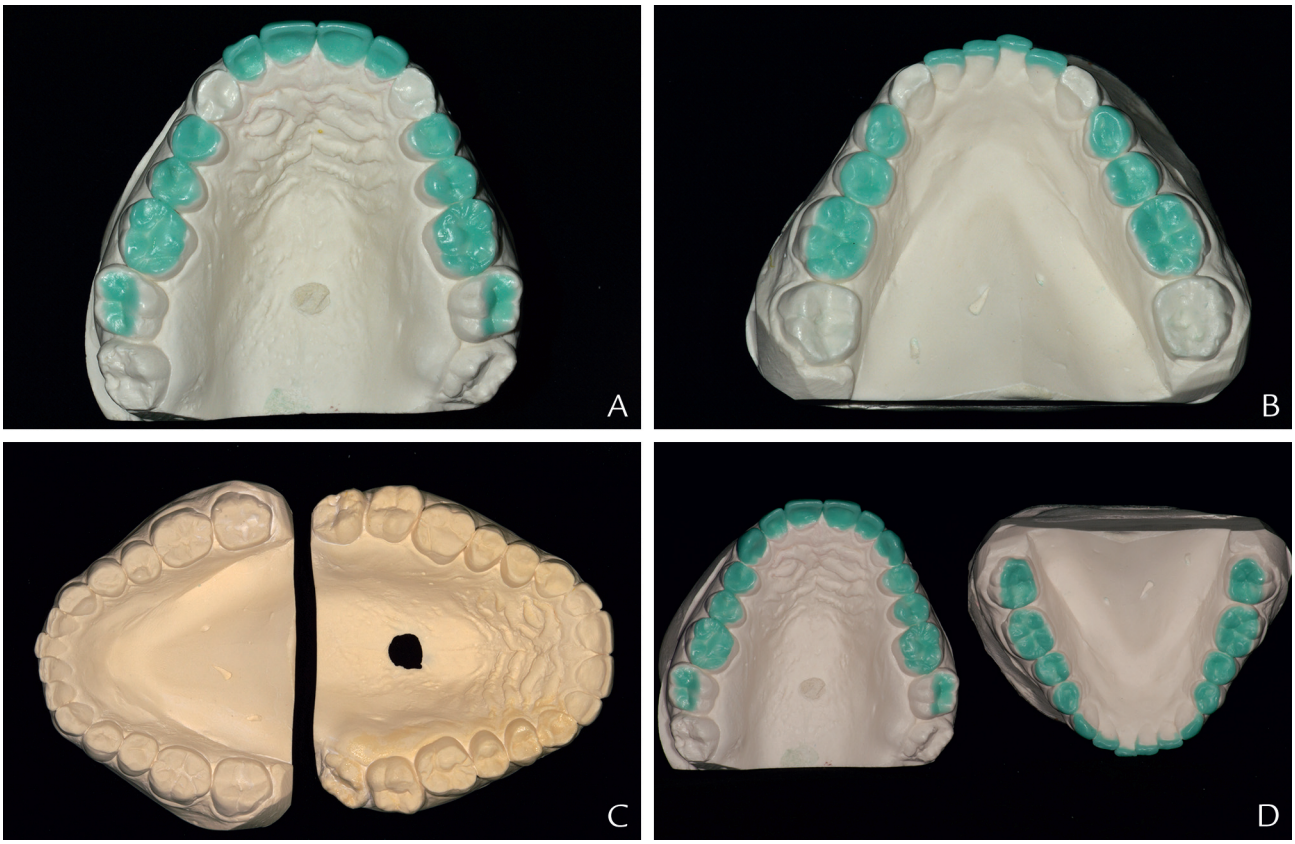

Figure 2. A, B, Waxing with four unaltered teeth as repositioning reference. C, Scannable stone replica of waxed cast. D, Complete waxing (including canines and mandibular second molars).

sensation, and stomach aches. He also admitted frequent ingestion of soft and sports drinks (more than twice a day) as well as nocturnal bruxism. The history suggested a mixture of extrinsic and intrinsic causes for dental erosion, although gastroesophageal reflux disease was not confirmed by his physician. Additionally, the existence of wear facets clearly marked in the functional cusps suggested a combination of erosion and attrition disorders. The patient was advised to control the intake of acid drinks and continue medical care.

The treatment was arranged in 2 phases, ultrathin CAD-CAM composite resin occlusal veneers on the posterior teeth and a bilaminar approach (palatal composite resin veneers and labial ceramic veneers)[24,25] on the maxillary anterior teeth. Along with data collection, complete arch polyvinyl siloxane impressions were made with a 1-step, double-mixture technique to obtain accurate diagnostic casts (Pearl white GC Fujirock EP; GC America). The occlusal relationship was recorded at the maximum intercuspal position. The VDO was increased by 2 mm to allow space for the restoration on the palatal aspect of the maxillary anterior teeth and to minimize the amount of tooth preparation required to accommodate the ultrathin occlusal posterior veneers.

With the assistance of a smile analysis performed with software (PowerPoint v14.5.9; Microsoft Corp), a partial diagnostic waxing of the 6 maxillary anterior teeth and intraoral trial restorations (used for 3 hours) provided an assessment for the appropriate positioning of the incisal edges and the ideal length of the posterior maxillary teeth. Upon acceptance by the patient, a complete-mouth additive waxing was ordered (GEO Classic mint-opaque wax; Renfert) and carried out in 2 steps by the dental technician. First, the entire arches were waxed, except for the canines and the most distal molars (Fig. 2A, B). The waxed cast was then duplicated (Elite Double 32 Fast; Zhermack) and poured with scannable stone (Snow rock 3D Scan; DK) (Fig. 2C). Those steps allowed the intraoral repositioning of silicone guides for trial restoration fabrication, selective preparation, and interim restorations and enabled the use of the biogeneric copy in the software (CEREC inLab v4.0.2; Sirona Dental Systems) to generate the restorations. Intact canines and the most distal molars allowed the correlation between the waxed casts and the preparations. In a second phase, the waxing was completed by the technician to restore those teeth and the mandibular incisal edges (Fig. 2D).

Carious lesions were restored with direct composite resin (IPS Empress Direct; Ivoclar Vivadent AG), and nightguard vital bleaching was provided at the patient's request.

At the next appointment, the posterior trial restorations were fabricated intraorally (Protemp 4; 3M

Figure 3. A, Silicone index in position during trial restoration fabrication. B, Trial restorations made of bis-acrylic composite resin. C, Patient evaluated for general appearance of the occlusal "re-enamelization" and impact of the new vertical dimension on facial profile and general comfort. D, Trial restorations easily removed. Distinctly thinnest areas measured with a caliper. E, Reduction areas mapped. F, Selective enamel reduction to conform with minimum thickness required for ultrathin occlusal veneers. G, Removal of excess adhesive resin from enamel margins after immediate dentin sealing.

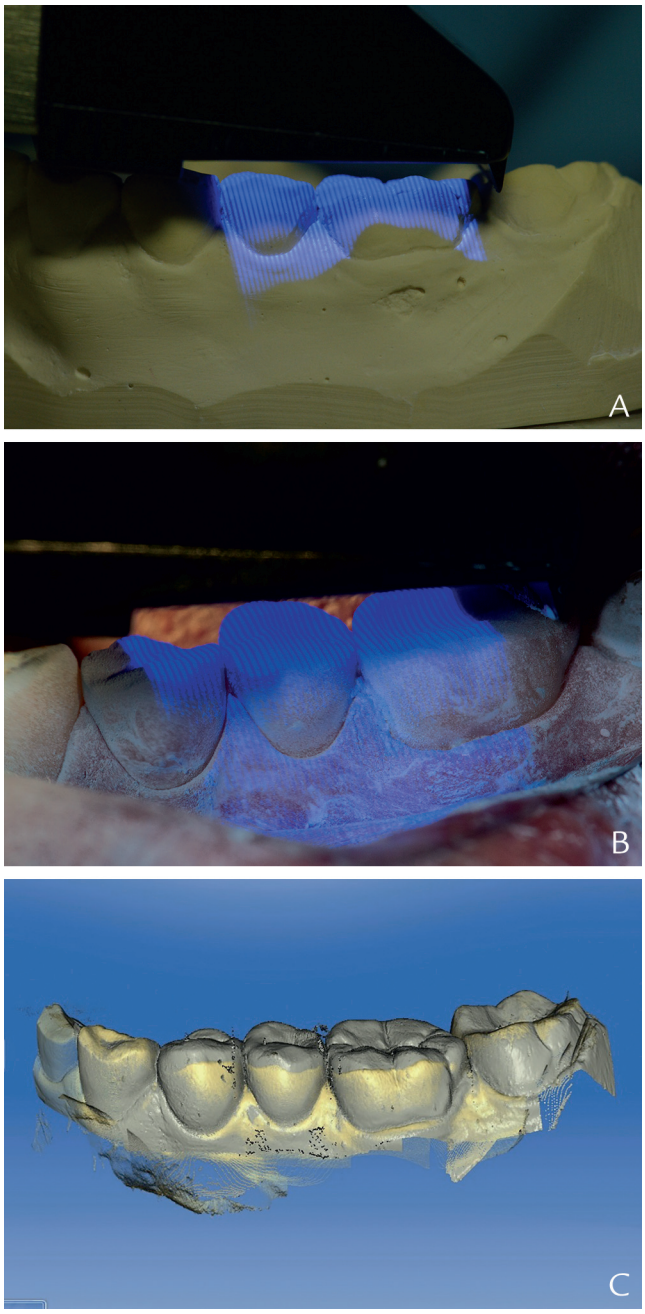

Figure 4. A, Scanning of additive waxing replica. B, Powdering and scanning of prepared teeth. C, Correlated models with preview of restorative design.

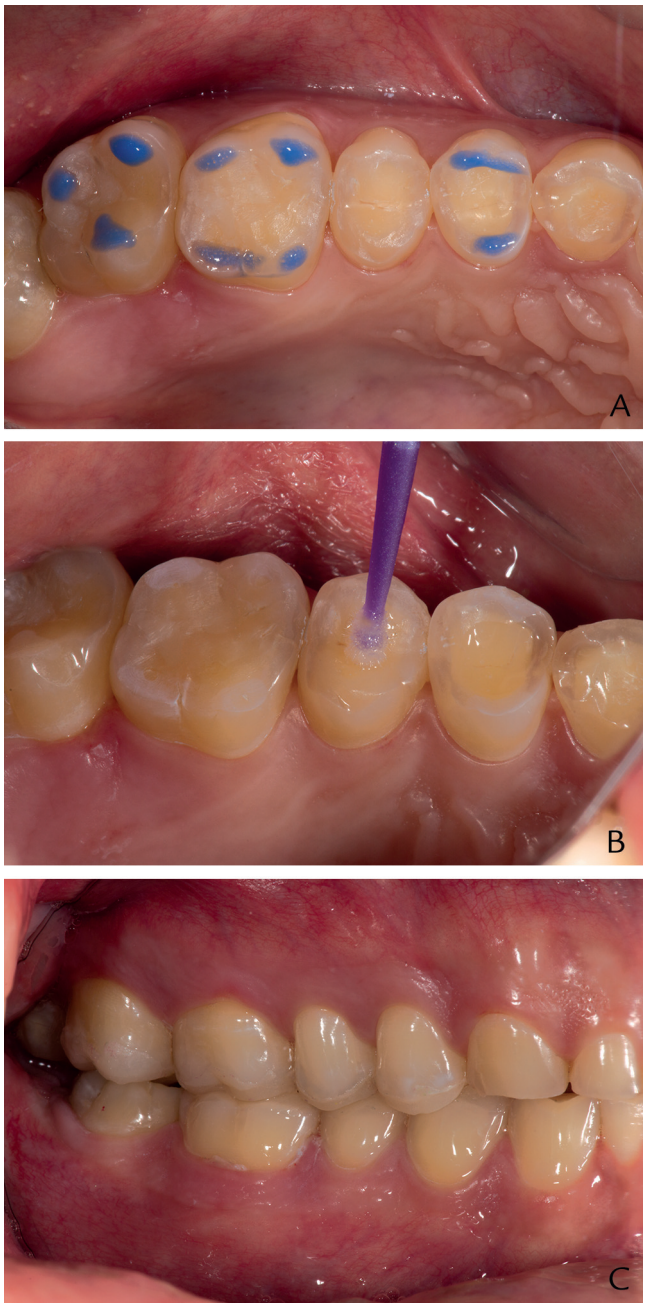

Figure 5. A, Additional retention for interim restoration phase. Spot-etching of prepared enamel margins with 37.5% phosphoric acid. B, IDS resin coating protected with water-soluble separating agent. C, Acrylic resin interim restorations.

ESPE) (Fig. 3A-C). It was useful to ascertain the influence of new VDO in facial appearance as well as assess muscle comfort. The trial restorations were tested for a few hours. Upon the patient's approval, the trial restorations were easily removed and used as a thickness guide for the preparations (Fig. 3D). The thinnest areas were measured with a caliper, mapped in the mouth (Fig. 3E), and then selectively reduced with tapered diamond rotary instruments (product code: 850,314,023; Komet) (Fig. 3F). An average occlusal clearance of 0.4 to 0.6 mm (central groove) to 1.0 to 1.3 mm (cusp tips) was generated for the ultrathin occlusal veneers. A rubber dam was placed, and all areas of dentin exposure were ground with a coarse diamond rotary instrument at low speed (1500 rpm)[26,27] and immediately sealed using a 3-step etch-and-rinse dentin bonding agent (OptiBond FL; Kerr Corp),[17] (Fig. 3G). The 4 quadrants were prepared over 2 consecutive days. The additive wax replica was scanned first for correlation (Cerec Bluecam; Sirona Dental

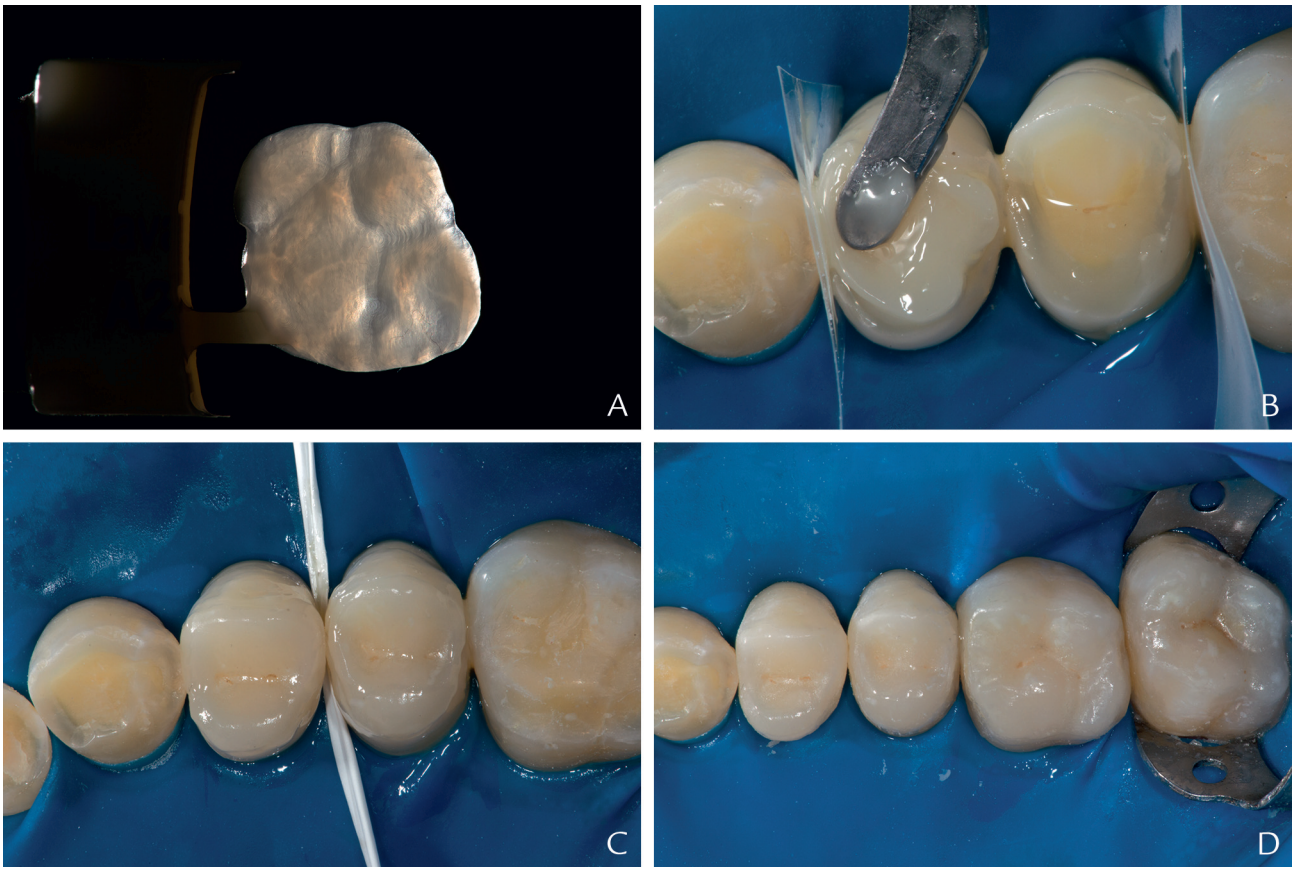

Figure 6. A, Restoration of first maxillary molar after milling. B, Adhesive resin placed followed by luting material (Filtek Z100; 3M ESPE) preheated to 68°C. C, Excess removal using Teflon strips in interproximal areas before light polymerization. D, Luting completed in maxillary left quadrant.

Systems) (Fig. 4A). The prepared teeth were then scanned in the same way, including the 2 unprepared teeth located at both ends of the scan (canines and rearmost molars) (Fig. 4B, C).

Direct splinted interim restorations were fabricated using silicone indexes loaded with a poly(methyl methacrylate) resin (Dencôr Lay; Clássico). Because of the nonretentive geometry of the preparation, a selective bonding protocol was used to increase the primary stability of the interim restorations without interfering with the integrity of the dentin sealing. Initially, spot-etching of the prepared enamel was carried out with 37.5% phosphoric acid (Ultra-etch; Ultradent Products Inc) (Fig. 5A). Then, the previously sealed dentin exposures were isolated with a separating agent (Pro-V Coat; Bisco) to prevent potential resin bonding to the autopolymerizing acrylic resin (Fig. 5B). Additional stability was obtained by not retrieving the interim restoration during fabrication (the so-called "shrink-fit" method).[28] Minor acrylic resin excesses in the cervical embrasures also provided some degree of locking. The patient remained at the interim restoration stage for a week to test the adaptation to the new VDO (Fig. 5C).

The teeth were restored using Cerec AC with the Bluecam/MCXL CAD-CAM system (Sirona Dental Systems). By using the design tools of the software (InLab v4.0.2; Sirona Dental Systems) set in Biogeneric Copy, the restorations were designed by correlating the preparations with the anatomy of the additive waxing. The ultrathin occlusal veneers were milled from composite resin blocks (LAVA Ultimate HT; 3M ESPE) (Fig. 6A) and polished mechanically with silicon carbide-impregnated brushes (Jiffy Brush; Ultradent Products Inc).

The restorations were adhesively cemented over 2 consecutive days for right and left sides, one quadrant at a time. No anesthesia was needed. After the interim restorations were removed, they were evaluated (Variolink Veneer try-in; Ivoclar Vivadent AG) for marginal fit and general occlusal contact, with the patient occluding gently. The restorations were then rinsed and prepared for luting. Surface conditioning of restorations included airborne-particle abrasion with 50-μm aluminum oxide at 0.2 MPa and air-water spray cleaning for 30 seconds. After being air-dried, the intaglio surfaces were silanated (Monobond Plus; Ivoclar Vivadent AG) and heat dried at 68°C for 5 minutes (Calset; AdDent Inc). The tooth preparations were airborne-particle abraded and etched for 30 seconds with 37.5% phosphoric acid (Ultra-Etch; Ultradent Products Inc), rinsed, and dried. Adhesive resin

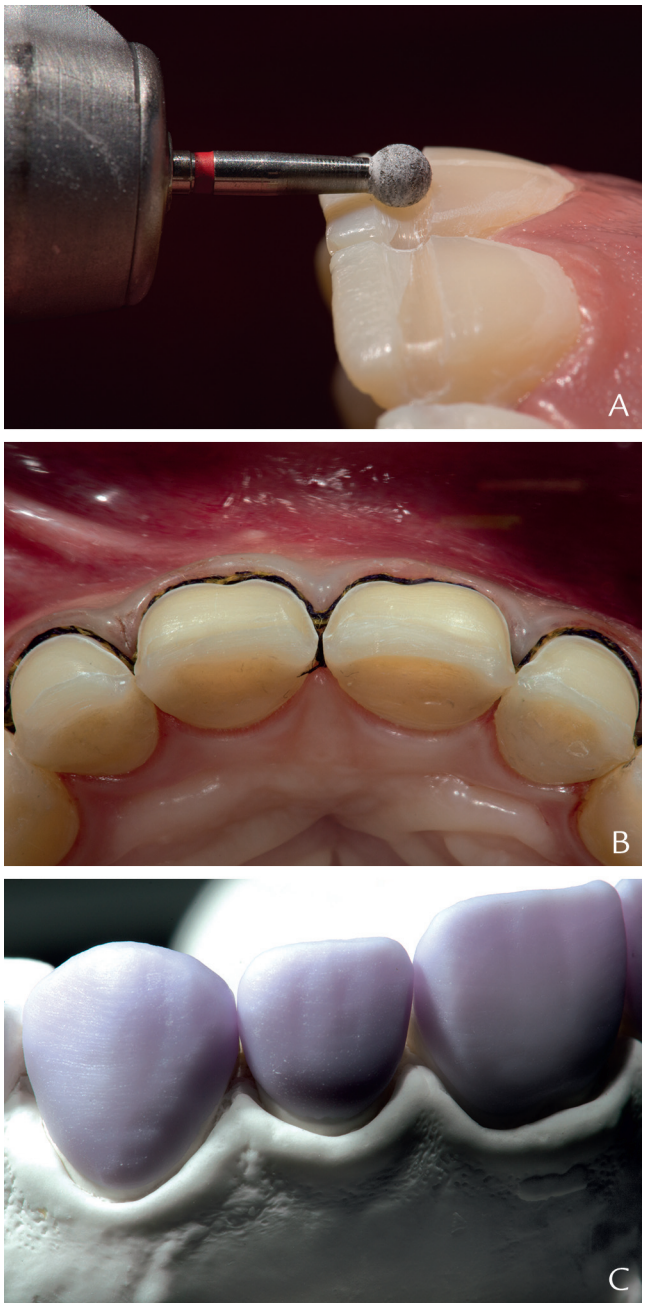

Figure 7. A, Trial restorations-driven depth cuts with round diamond rotary instrument. B, Definitive veneer preparations. C, Lithium disilicate veneers in blue phase. Texture of restorations was modified with diamond rotary instruments (first vertical developmental grooves, then perikymata).

(Optibond FL, bottle 2; Kerr Corp) was applied to both fitting surfaces of the restoration and the tooth and left unpolymerized while protected from direct light. After the luting material (Filtek Z100; 3M ESPE), preheated to 68°C (in Calset; AdDent), was applied to the tooth (Fig. 6B), the restorations were individually seated, followed by the elimination of excess composite resin (Fig. 6C) and initial light polymerization. Preheated traditional light-polymerizing composite resins provide several advantages including unlimited working time, ideal consistency for seating and excess removal, and better mechanical properties because of the higher filler content and higher degree of conversion.[29,30] Each surface was exposed at 1000 mW/cm^2 (Valo) for 60 seconds (20 seconds per surface, repeated 3 times). The margins were then covered with an air barrier (K-Y Jelly; Johnson & Johnson) and light polymerized for an additional 20 seconds (Fig. 6D). Only minor occlusal adjustments were necessary. The margins were finished and polished at the following appointment with diamond ceramic polishers (W16Dg, W16Dmf, and W16D; EVE Diapol; EVE Ernst Vetter GmbH) and silicon-impregnated rubber polishers (Jiffy; Ultradent Products Inc). The second mandibular molars were then restored in the same way, using the diagnostic waxing as a reference.

Once the posterior teeth had been restored to a stable occlusion, the maxillary anterior teeth were restored according to the bilaminar approach.[24] Because of the existing clearance, the preparation of the lingual aspect was limited to the grinding of the exposed dentin[17,26,27] with a diamond rotary instrument at low speed (1500 rpm) and by slightly stripping the large proximal contacts. The dentin was immediately sealed (Optibond FL; Kerr Corp). Definitive impression was then made (Virtual; Ivoclar Vivadent AG). A transparent matrix (Elite Transparent; Zhermack) was used to guide the fabrication of the layered indirect composite resin palatal veneers (IPS Empress Direct; Ivoclar Vivadent AG). In the following appointment, the palatal veneers were luted using the same protocol used in the posterior restorations. At the end of this step, most of the anterior guidance had been established.

The facial and incisal deficiency was finally addressed with conventional stained ceramic veneers (e.max CAD; Ivoclar Vivadent AG) (Fig. 7). Finally, for integration of the smile and improvement of the anterior guidance, direct composite resin (IPS Empress Direct; Ivoclar Vivadent AG) was used to restore the incisal edges of the mandibular anterior teeth (Fig. 8).

DISCUSSION

The main advantage of the approach presented here was the rehabilitation of severe dental erosion by using a minimally invasive and predominantly additive technique. Despite the limited increase in VDO, the authors decided to provisionalize and observe the patient until his complete adaptation (less than 1 week). In addition, the presence of interim restorations made the treatment more flexible, allowing the clinician to work on 1 quadrant or on 2 opposing quadrants per appointment if needed, such as for restoration delivery.

Figure 8. A, B, Occlusal views of maxillary posterior teeth. C, Right and D, left sextants in occlusion. Note excellent tooth-restoration blending. E, F, Occlusal views of definitive restorations. G, Smile after treatment.

The treatment option adopted saved chair time. The restorative phase was completed in as little as 4 weeks. The simplicity of the design (minimum or no preparation, margins highly accessible), assisted by the additive waxing and availability of a CAD-CAM system accelerated the workflow. However, the technique required attention and precision, especially during preparation and cementation, because smaller dimensions and nonretentive preparation design were involved.

As restorative materials of choice for ultrathin occlusal laminates, composite resins and ceramics are able to meet the requirements of biomimetics, saving dental tissues and restoring esthetics.[5,18,19] However, CAD-CAM composite resins may provide better fracture resistance for nonretentive ultrathin occlusal veneers in posterior teeth under extreme load conditions.[5]

Research is required to assess the clinical performance of ultrathin occlusal veneers. Therefore, a clinical trial is being undertaken at the Federal University of Rio de Janeiro. The new design is being offered to patients affected by moderate to severe erosion in 2 different CAD-CAM materials (composite and ceramic).

SUMMARY

This clinical report describes the CAD-CAM rehabilitation of a young adult patient with severe dental erosion, using an innovative approach. The treatment was performed with a minimally invasive approach through ultrathin CAD-CAM composite resin occlusal veneers in posterior teeth, using a predominantly additive approach that included an increase in the vertical dimension of occlusion. The maxillary anterior dentition was restored with a bilaminar approach associating composite resin lingual veneers with lithium disilicate labial veneers. Restorative treatment was completed within 1 month, at which time the biomechanics, function, and esthetics were blended, resulting in a noticeable improvement in the patient's oral health and appearance. Clinical investigations have been initiated to assess the performance of these restorations in the long term.

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Corresponding author:
Dr Luís Henrique Schlichting
Department of General Dentistry, East Carolina University School of Dental Medicine
1851 MacGregor Downs Rd, Mail Stop #701
Greenville, NC 27834
Email: luishschlichting@gmail.com

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