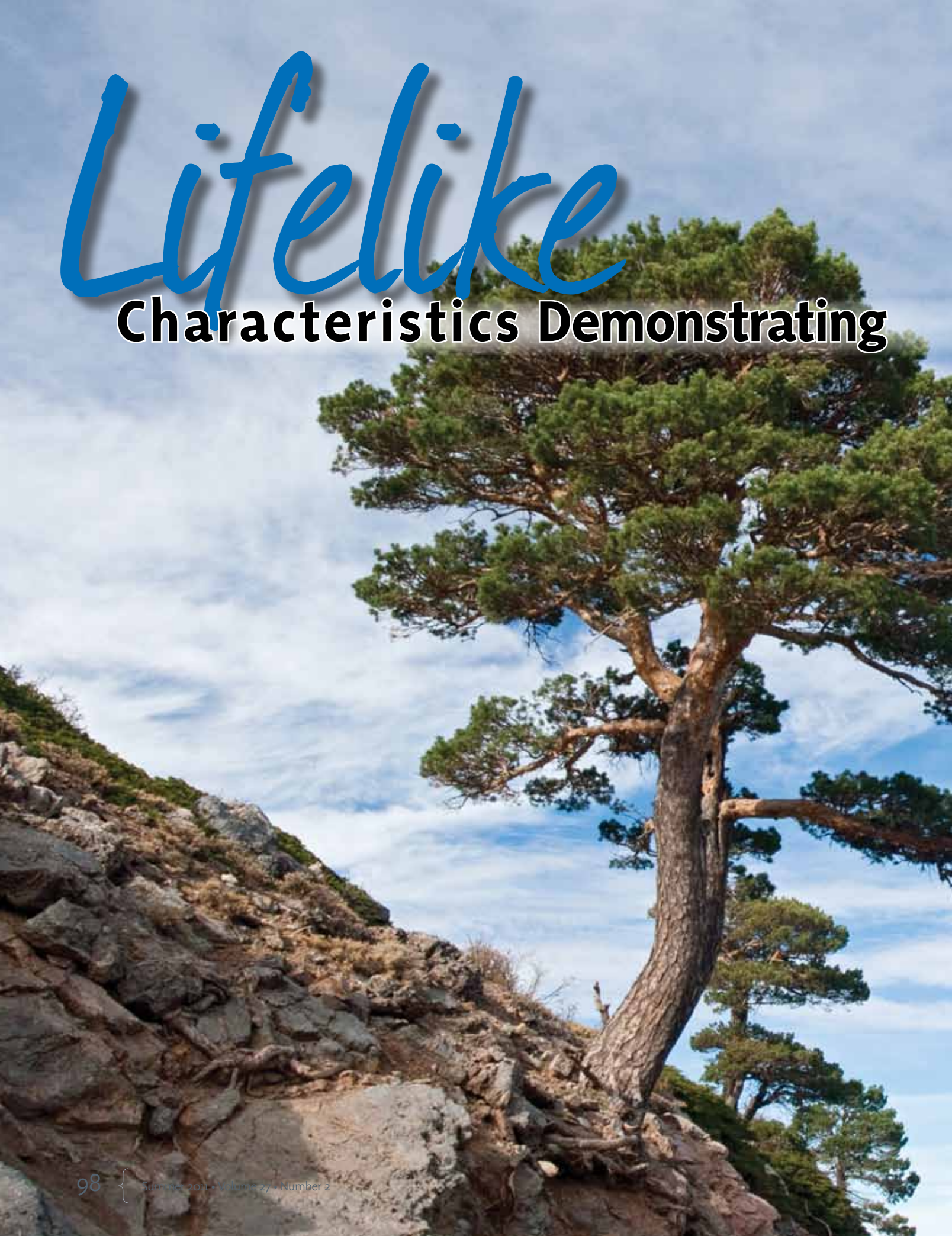
Lifelike Characteristics Demonstrating



Predictable Durability

Increasing All-Ceramic Treatment Durability in the Esthetic Zone Using Lithium Disilicate Restorations

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Introduction

Restorations in the esthetic zone require fabrication from materials exhibiting the most lifelike characteristics while demonstrating predictable durability. Currently, most veneer restorations are created using stacked feldspathic porcelain, whereas many crowns are either metal-ceramic or all-ceramic with zirconia cores. The use of zirconia substructures as cores for ceramic crowns has provided an obvious esthetic advantage over masking darkened metal cores and frameworks while providing high flexural strength.[1] There are, however, shortcomings to zirconia technology, and lithium disilicate crown and veneer restorations (e.g., IPS e.max, Ivoclar Vivadent; Amherst, NY), offer promise for overcoming many of the obstacles faced with zirconia.

Figure 1: A 57-year-old woman was displeased with the appearance of her smile.

Literature Review

For example, zirconia provides a strong substructure, but the bond between the layering ceramic and zirconia appears to be an "Achilles heel." A problem that has plagued clinical trials of zirconia-cored restorations is a high rate of chipping of the veneering ceramic.[2,3] In their review of the literature, Donovan and Swift concluded that veneered zirconia crowns should not be used routinely on molars or for multi-unit restorations.[4] After experiencing veneering fractures on 50% of zirconia three-unit fixed partial dentures, Christensen and Bloeger concluded that veneer ceramics for zirconia need improvement.[5]

In a bench test using a rapid prototyping die, investigators at New York University (NYU) compared fully contoured crowns made with veneered IPS e.max ZirCad/Ceram zirconia cores with crowns made of IPS e.max CAD monolithic lithium disilicate. To simulate mouth motion, an indenter was cyclically slid lingually down the disto-buccal cusp of the samples during step-stress fatigue. Chipping of hand-layered veneered zirconia crowns occurred, whereas none of the computer-aided design/computer-assisted manufacturing (CAD/CAM)-fabricated monolithic lithium disilicate crowns failed during step-stress of the disto-buccal cusps.[6] While not quite approaching the flexural strength of monolithic zirconia, the machined lithium disilicate is much stronger than feldspathic ceramics, demonstrating a flexural strength of 400 MPa in pressable form (e.g., IPS e.max Press).[7] In particular, in an in vitro investigation, Stappert and colleagues[8] demonstrated failure loads from 1,560 to 1,960 newtons under masticatory fatigue loading for partial-coverage crowns on molars using the pressable form of lithium disilicate. Another in vitro study, by Silva and colleagues at NYU, using the same apparatus as described above, tested first molar crowns cemented onto dies with resin cement and found results similar to Stappert et al. Recorded strength values were 1,719, 1,304, and 631 newtons for lithium disilicate, metal ceramic, and veneered zirconia crowns respectively.[9] In a private practice setting, Valenti and Valenti demonstrated a 95.5% success rate of 261 IPS Empress 2 anterior and posterior lithium disilicate crowns after 10 years in service. Only eight crowns failed (six due to chipping and two due to core fractures).[10] Additionally, Reich and colleagues reported that 41 chair-side-generated CAD/CAM posterior lithium disilicate crowns in 34 patients remained in situ after 24 months of observation.[11] Unlike zirconia, lithium disilicate is etchable due to its glassy phase, and initial data for bonded single restorations are excellent.[12,13] The above-referenced studies indicate that lithium disilicate crowns should prove more durable in clinical practice than crowns with zirconia cores.

The inherent opacity of zirconia is another limitation that can have a significant impact on esthetic results.[14] A supposed advantage of all-ceramic materials is improved transmission of light. Zirconia, however, is relatively opaque, and light striking the bright core is actually reflected and scattered.[15] In the author's experience, this opacity creates two additional problems. First, technicians accustomed to opaquing darker metals must relearn their opaquing techniques to compensate for bright zirconia cores. Secondly, if crowns and veneers are combined in the same arch, it is difficult to obtain a shade match and similar optical properties between the dissimilar feldspathic veneers and zirconia-cored crowns.[16]

Lithium disilicate, however, provides a distinct advantage in translucency over opaque zirconia, mimicking the light transmission observed in natural teeth. Ingots are produced with varied optical properties: high opacity (HO), medium opacity (MO), low translucency (LT), and high translucency (HT).[17] Secondly, because veneers and crowns can both be made with lithium disilicate, technicians are not burdened with attempting to achieve shade and optical matches between dissimilar materials.

Two case presentations are described here to demonstrate the manner in which all-ceramic restorations for the esthetic zone were treatment planned for lithium disilicate restorations to ensure durability, esthetics, and seamless integration between a combination of restorations.

Figure 2: Maxillary anterior teeth were darkened, worn, and disproportionate, and the premolars were discolored.

Figure 3: The mandibular teeth displayed gingival erosion and dark triangles between the anterior teeth.

Case Presentation #1

Findings

A 57-year-old woman who was unhappy with the esthetics of her smile presented for treatment **(Fig 1)**. Her anterior teeth were slightly misaligned, darkened, worn, disproportionate, and exhibited black triangles **(Figs 2 & 3)**. Orthodontic therapy had been completed several years earlier, but the patient admitted that she was not compliant in wearing her retainer. Her wide smile also displayed the first premolars, which previously had been restored with metal-ceramic crowns, also to a darkened shade.

Treatment Plan

Following a thorough examination and consultation, several treatment options were discussed. Reinstitution of orthodontics was suggested, but the patient declined. Whitening had been attempted previously with little success, and this option would not address issues of unesthetic contours and the darkened premolars that had been restored earlier. Incisal edge lengthening was required for proportionate contours and the author considered that composite resin restorations would carry a high risk of fracture. The selected treatment plan included veneers on the maxillary and mandibular anterior teeth and intact premolars, and replacement crowns on the previously restored premolars. Because veneer and crown restorations were required in the same arch, which also had to blend with relatively translucent natural teeth, lithium disilicate was the material of choice for the patient's rehabilitation.

Lithium disilicate crown and veneer restorations...offer promise for overcoming many of the obstacles faced with zirconia.

Treatment

Casts of the patient's existing dentition were made and articulated and a diagnostic wax-up completed to address the patient's esthetic priorities, refine the anterior alignment, and improve her occlusion. The wax-up was duplicated in stone **(Figs 4 & 5)**, and putty matrices were made to serve as preparation guides and to aid in the creation of provisional restorations **(Fig 6)**.

The selected shade for the restorations was agreed upon by the patient and prosthodontist **(Fig 7)**. Maxillary anterior veneer and premolar crown preparations were completed first **(Fig 8)**. Mandibular preparations were undertaken next, and veneers were planned for the anterior teeth. However, even after minimal preparation, significant dentin exposure and insufficient enamel substrate precluded the use of veneers on the mandibular incisors. Therefore, the preparations were converted to those for full-crown restorations, the intact premolars prepared for veneers, and a single right second premolar was re-prepared for a replacement crown.

A stump shade was selected after preparations were complete **(Fig 9)**. Provisional restorations were made from the diagnostic wax-up using bisacryl resin (Structur Premium, VOCO America; Briarcliff Manor, NY) and cemented using a self-adhesive cement (Rely X Unicem, 3M ESPE; St. Paul, MN) **(Fig 10)**. The author has used this cement for many years for predictable retention of provisional veneers. Using a hemostat, they are not particularly difficult to remove, and leave a clean and etchable enamel surface that has no untoward effect on cementation of definitive veneers. The patient was instructed to evaluate this esthetic template and report any desired modifications.

Impressions were made and casts sectioned. Maxillary dies included six anterior veneers and two crowns for the first premolars. The fabricated lithium disilicate veneers and crowns demonstrated an intimate interface between the chamfer margins and the restorations **(Fig 11)**. Veneers and crowns for the mandibular dies were designed for ideal arch alignment **(Fig 12)**.

Figure 4: The maxillary teeth were ideally waxed and duplicated in stone.

Figure 5: The mandibular teeth were aligned and proximal spaces closed.

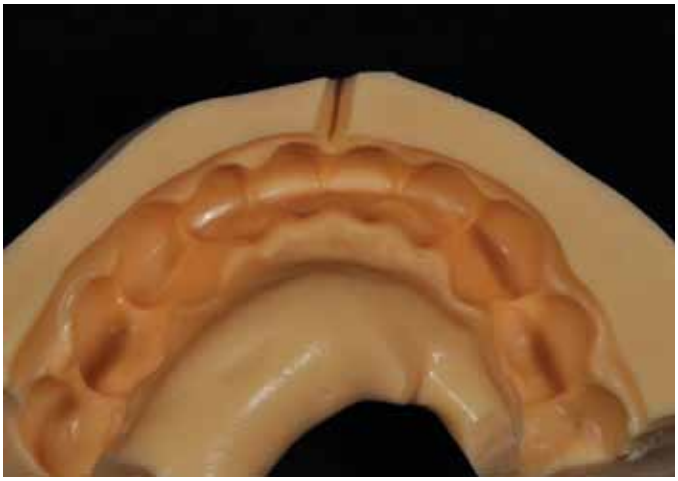

Figure 6: A silicone putty matrix of each arch was made for use as a preparation guide and for making provisional restorations.

Figure 7: The dentist and patient selected a mutually agreed-upon shade.

Figure 8: The maxillary anterior teeth were prepared for ceramic veneers and the first premolars for ceramic crowns.

Figure 9: Following tooth preparation, a stump shade was selected.

Figure 10: Provisional veneers, predicated on the diagnostic wax-up, were seated with self-etching cement.

Figure 11: Lithium silicate veneers and crowns were fabricated.

Figure 12: The completed lithium disilicate veneers and crowns on the mandibular arch reestablished the ideal arch form.

Figure 13: The seated maxillary restorations improved tooth color, contour, proportions, and alignment while maintaining gingival health.

Figure 14: Mandibular veneers and crowns effectively eliminated proximal spaces and established ideal tooth alignment.

Figure 15: The patient's goal of a more youthful and esthetically balanced smile was achieved.

Figure 16: A 25-year-old woman presented with eroded maxillary anterior teeth.

The seated maxillary lithium disilicate crowns and veneers (IPS e.max) maintained the patient's gingival health while creating a youthful and translucent appearance to her smile **(Fig 13)**. The mandibular veneers and crowns achieved the objective of improved arch alignment, closure of interproximal spaces, and corrected maxilla-mandibular relationships **(Fig 14)**. Smile esthetics met the patient's expectations for improved proportions, elimination of spaces, correct alignment, and youthful shade **(Fig 15)**.

Case Presentation #2

Findings

A 25-year-old woman presented with eroded maxillary anterior teeth due to a history of bulimic reflux **(Fig 16)**. Facial enamel and incisal edges of the maxillary incisors were affected **(Fig 17)**. Posterior teeth were unaffected, but the palatal enamel of the incisors was extremely eroded **(Fig 18)**. Radiographically, no apical pathology was noted, and bone levels were normal **(Fig 19)**, but her lower anterior teeth were misaligned.

Treatment Plan

Treatment options included orthodontic therapy, primarily to realign the mandibular anterior teeth and restoration of the maxillary anterior incisors and possibly the canines. Continued monitoring of the erosion without restoration was not an option presented. Tooth loss was excessive, particularly for the patient's age, and renewed esthetics was a patient priority. There was insufficient remaining enamel for composite resin restorations or ceramic veneers. Orthodontic treatment was undertaken and completed, and four lithium disilicate ceramic crowns (IPS e.max) were treatment planned with the objective of restoring lost tooth structure both facially and palatally, as well as esthetically blending the anterior four crowns with the intact remaining teeth. The author and patient decided to monitor the canines for further tooth loss and restore them at a later date if necessary.

Treatment

At the preparation appointment, an appropriate shade was selected **(Fig 20)**. The four maxillary incisors were initially prepared and a stump shade was chosen **(Fig 21)**. Preparations were then completed without gingival trauma **(Fig 22)**. Predicated on a diagnostic wax-up, a provisional restoration was made with bis-acryl resin and seated using a temporary cement **(Fig 23)**.

Lithium disilicate was chosen primarily because its translucent optical properties would blend best with the young patient's relatively translucent maxillary canines and posterior teeth **(Fig 24)**.

The patient returned after three weeks, at which time the crowns were acid-etched, silinated, and seated using a dual-cure, self-etching adhesive (Panavia F 2.0, Kuraray America; New York, NY) **(Fig 25)**. Cementation of lithium disilicate restorations can be successfully accomplished using traditional cements such as zinc phosphate,[18] but improved bond strengths have been demonstrated with etching with hydrofluoric acid and application of silane primer[19] followed by self-adhesive resin cements.[20] Optimal anterior occlusion was established, tissue health was maintained, and the crowns blended seamlessly with the natural dentition **(Fig 26)**. A rejuvenated smile was the patient's ultimate goal **(Fig 27)**.

Conclusion

The availability of a restorative material such as lithium disilicate for the fabrication of durable metal-free restorations suitable for placement throughout the oral environment is a huge leap toward dentistry's goal of optimizing esthetic outcomes using a ceramic material with demonstrated longevity. The cases discussed in this article demonstrate that natural teeth, crowns, and veneers can be nearly indistinguishable when lithium disilicate is the selected ceramic material. Documented long-term durability, the ability to use it for crowns and veneers, and improved optical properties position lithium disilicate as a material for consideration in esthetically critical dental rehabilitations.

Figure 17: The facial enamel and incisal edges of the maxillary incisors were affected.

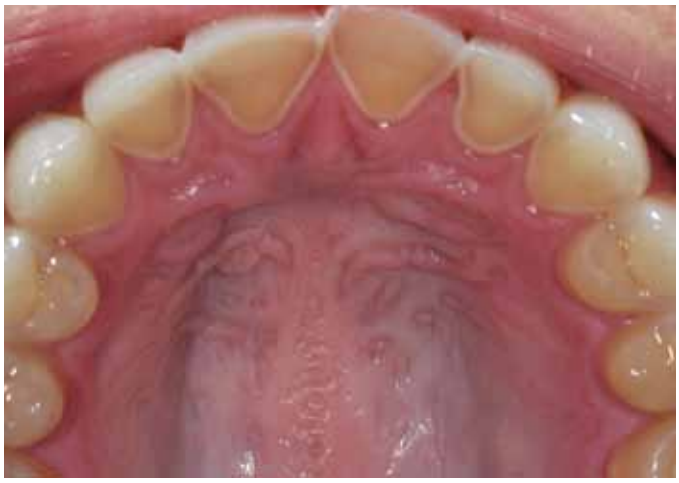

Figure 18: The posterior teeth were unaffected, but the palatal enamel of the incisors was extremely eroded.

Figure 19: Radiographically, no apical pathology was noted and bone levels were normal.

Figure 20: At the preparation appointment, an appropriate shade was selected.

Figure 21: The four maxillary incisors were prepared and a stump shade was chosen.

Figure 22: Preparations were then completed without gingival trauma.

Figure 23: The seated provisional crowns served as a template for the definitive crowns.

Figure 24: The lithium disilicate crowns demonstrated good marginal fit on the dies.

Figure 25: The patient returned after three weeks, at which time the crowns were seated using a self-etching cement.

Figure 26: Optimal anterior occlusion was established, tissue health maintained, and the crowns blended seamlessly with the natural dentition.

Figure 27: A renewed smile was the patient's ultimate goal.

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