Achieving Aesthetic and Functional Success

INTRODUCTION
Vital to the protection and integrity of the masticatory system, dentists have the responsibility of developing proper form and function when undertaking any restorative case. The key to long-term stability, correct anterior guidance, or the direction of forces applied to the anterior dentition, can have a significant affect on the success or failure of restorations.

Occlusion
Often overlooked, occlusion plays an important role in not only function, but also in aesthetics. To achieve predictable results, it is necessary for dentists and ceramists to completely understand the masticatory forces that will be placed on the restorations, including a patient’s parafunctional habits.

Dentists typically work with a patient’s occlusal relationship as it exists. However, this often proves detrimental to the stability of the masticatory system and can cause early failure of restorations. Manifesting as muscular pain, joint problems, wear, chipping, tooth mobility, sensitivity, an uncomfortable bite, and a variety of other symptoms, malocclusion can be a cause of many problems for patients. If left unaddressed during the aesthetic and functional restorative process, porcelain fractures, cement fatigue, and tipped occlusion minimizes the patient’s risk for developing temporomandibular disorder problems, since there is a reduction in lateral and in opposing tooth contacts.

To achieve aesthetic restorative success, dentists and their dental laboratory team must control the forces applied to the teeth. Typically determined through trial and error on the articulator, the ideal OVD should be selected based on the aesthetics of the maxillary and mandibular incisor incisal edge position, the restorative needs of the anterior and posterior dentition, and the functional needs of the overbite and overjet.

Bruxing
Of the many parafunctional habits with which patients may present, bruxing is commonly a cause of severe wear and pain. Typically viewed as a dysfunction of the TMJ, bruxing is actually a result of a neurological dysfunction and may also be a stress-releasing function. No matter the case, the dentist and dental laboratory team must make careful considerations when treating patients with bruxism. Materials prone to chipping and fracture should not be used, since the patient’s bruxing habit will likely continue even after restorative treatment.

In cases requiring all-ceramic restorations, a system that is wear and fracture resistant is required to meet the needs of the bruxer patient and to avoid the need for protective mouth guards.

Historically, conventional all-ceramic systems have provided dental professionals with predictable and efficient treatments for highly aesthetic cases. Most aesthetic materials, however, often fail when placed under the stress of typical parafunctional continued on page 146
habits.\textsuperscript{7} The choice of dentists and dental technicians for many years, metal-based ceramic restorations, solved some of the fracture and chipping issues associated with conventional porcelain systems.\textsuperscript{3-7} Although these systems could withstand the stresses of function, they often lacked the aesthetics of all-ceramics, and some chipping still occurred.\textsuperscript{3-7}

Utilizing a monolithic technique, lithium disilicate pressable ceramic systems (such as IPS e.max Press and IPS e.max CAD [Ivoclar Vivadent]) help to solve some of these historical problems, while exhibiting the physical and optical characteristics desired by even the most demanding of patients and dental professionals.\textsuperscript{7-10}

Delivering the fit, form, and function of conventional pressable ceramics, lithium disilicate glass ceramic also demonstrates enhanced strength and optimized optical properties.\textsuperscript{7-10}

Indicated for thin veneers, veneers, partial crowns, posterior and anterior crowns, inlays, onlays, 3-unit anterior bridges, 3-unit premolar bridges, telescope primary crowns, and implant superstructures, lithium disilicate offers solutions for many different clinical needs.\textsuperscript{8-10} Lithium disilicate can be used in settings requiring either conventional cementation (when adequate resistance and retention form is possible in the preparation design) or adhesive resin bonding, and the aesthetic and physical properties of this material allow dentists and ceramists to address functional and aesthetic concerns in a predictable manner.

**CASE REPORT**

**Diagnosis and Treatment Planning**

A 52-year-old female presented with concerns about her bite, grinding habits, gingival display, and the overall lack of aesthetics in her dentition. Upon consultation with the patient, it was discovered that as she had aged, she noticed that her teeth were gradually looking worse. She stated that she had never really liked the appearance of her teeth, and that her current situation negatively affected her self-confidence. She wanted to wear lipstick, something that she had never done before for fear of drawing attention to her smile. As a mother and active member of her community, she wanted a better smile.

Upon clinical examination, severe wear caused by bruxism was observed. This parafunctional habit led to issues with tooth proportion, length, contour, color, and function. In addition, the patient’s gingival levels were uneven, and there was excessive gingival display (Before Image and Figures 1 and 2).

The patient was well aware of her dental issues and that she would need a full-mouth reconstruction to correct them. Because the patient was a severe bruxer, a restorative material that would not fracture or chip easily would be required. First, it would be necessary to address the patient’s occlusal plane and anterior guidance challenges, while eliminating the posterior interferences. A diagnostic wax-up was planned to work out a solution and to guide the dental team in correcting aesthetics and occlusal issues. Additionally, a gingivectomy would be used to achieve the proper and aesthetic gingival levels.

Because the patient was missing her first premolars, the 16 anterior teeth were to be restored first, rather than the typical 20. The first and second molars initially would be left out of occlusion. Additionally, it was recommended to the patient that the remaining third molars be extracted at least 2 months prior to initiating treatment. Veneering of all mandibular teeth was preferred, as opposed to using crowns, to avoid lingually preparing the lower incisors since they were already thin.

Veneers for teeth Nos. 6 to 11 and onlay veneers for the upper premolars were also included in the treatment plan. In order to achieve the desired postoperative OVD, the occlusal surfaces of the premolars needed to be fully covered. However, it was not necessary to place the lingual margin of the preparations more than halfway past the palatal wall of the tooth, since the restorations would be adhesively bonded in place.

**Material Selection**

The patient wanted her restorations to mimic the appearance of natural teeth. In this case, we chose to use a pressed lithium disilicate all-ceramic (IPS e.max Press) to help us meet the patient’s stated aesthetic goal. When used as a monolithic material (without the use of layering porcelains), IPS e.max Press is a very strong (400 MPa biaxial flexural strength) all-ceramic material that can be resin-bonded for maximum strength. If desired, it can also be pressed to full contour, and then cut back and layered to create any special effects that may be needed within the aesthetic zone. Demonstrating exceptional strength, along with strength, form, and function, IPS e.max Press is an excellent material for the treatment of this patient.
AESTHETICS

Achieving Aesthetic...

continued from page 146

with high aesthetic values and optical properties, lithium disilicate is ideal for restorative cases where aesthetics and function must be predictably delivered.

Clinical Diagnostics

A thorough TMJ evaluation was first completed using a Joint Vibration Analysis (Bio-JAV Scan [Bio-RESEARCH Associates]) to assess the function and vibration patterns of the TMJ. All previous periodontal and restorative work was then charted. The patient’s dental history was unremarkable, with no major periodontal or dental work. Additionally, her TMJ was found to be stable before treatment.

A full set of diagnostic photographs and radiographs were then taken, and upper and lower impressions were made using a vinyl polysiloxane (VPS) impression material (Imprint 3 [3M ESPE]) to allow for multiple pours for the fabrication of diagnostic models. These impressions also enabled the patient to review her initial and final restorations on the articulator (Stratos [Ivoclar Vivadent]).

Utilizing an anterior deprogrammer that the patient wore for several days, a centric occlusion bite registration was taken, and her new post-restorative OVD was estimated. By using the deprogrammer, a repeatable condylar position was easily captured during the bite registration process. Additionally, by using upper and lower incisor cementoenamel junction (CEJ) to CE measurements using digital calipers (Erskine Dental), the proper vertical dimensions were further established. Simple and accurate, this method provided the dental laboratory team with sufficient information to mount the case in a centric relationship to the correct (estimated postrestorative) OVD. With clinical photographs, the ceramist was able to wax the case to ideal form and function.

As mentioned earlier, gingival architecture was also very important to achieving the desired final aesthetics of this case. Despite the excessive amount of facial gingival tissue that required removal, there was no issue with biological width. Working with the ceramist, the proposed tissue changes for the day of preparation were mapped, and a tissue reduction guide was created.

Clinical Preparation Protocol

The patient was anesthetized with a 4% articaine hydrochloride solution with 1:100,000 epinephrine (Septocaine [Septodont]) using a computerized anesthetic delivery system (The Wand [CompuDent]) to provide a more comfortable injection. While the patient was waiting for the anesthesia to take effect, a hard putty matrix (SilTech [Ivoclar Vivadent]) fabricated from the diagnostic wax-up was filled with a bis-acryl composite provisional material (Luxatemp [DMG America]) and seated over the unprepared teeth.

Since the restorative technique was an additive one, very little tooth structure was removed prior to this step. However, to seat the matrix, an initial reduction stent was used (Figure 3). The matrix was then removed and used as a guide to prevent overpreparation of the teeth (Figure 4).

The tissue guide made during the diagnostic stage was used to mark necessary tissue reductions that were to be made prior to any tooth preparation. To perform the gingivectomy, a radiosurgery unit (Ellman International) was utilized according to the reduction stent. The guide was then extracted, and excessive tissue was removed where necessary to establish an even scallop on each tooth.

Tooth preparation was initiated with diamond burs (KOMET USA) and an ELECTROTorque handpiece (KaVo). Utilizing polishing discs (Sof-Lex [3M ESPE]), rough/sharp edges were removed from the preparations, and they were given a final polish. Immediately after, final impressions were made using impression trays (Directed Flow Trays [3M ESPE]) filled with a heavy body VPS impression material (Imprint 3). To ensure successful impressions, the preparations were kept clean and fluid-free throughout the process.

To maintain the correct proposed OVD throughout the treatment process, a “bite-jig” was created from a rigid VPS bite registration material (Mega Bite [Discus Dental]) on the articulated wax-up of the molars. The 2 registrations, right and left, were used throughout treatment for bite verification and to maintain the correct vertical dimension. This “bite-jig” also assisted the laboratory ceramist in mounting the upper and lower preparation models to the correct vertical dimension.

Stump shades (Chromoscope Stump Shade Guide [Ivoclar Vivadent]) were then taken, along with a series of digital photographs for communication of case specifics with the dental laboratory team (Figure 5). Once completed, provisional restorations were ready to invest and press.
Achieving Aesthetic...

continued from page 148

tions were created. Telio Desensitizer (Ivoclar Vivadent) was applied to the preparations for 20 seconds each and air thinned prior to the application of OptiBond FL Primer (Kerr) to the preparation margins. This technique, when performed on the preparations prior to provisional fabrication, virtually eliminates sensitivity and substantially minimizes microleakage under the provisionals. The matrix was lined with a provisional material (Luxatemp) and placed over the preparations. Once the provisional material had set, the matrix was removed, and the provisionals were polished with polishing cups and points (Astropol [Ivoclar Vivadent]). A low viscosity liquid polish and sealant (BisCover [BISCO]) to prevent staining was placed over the temporary restorations. (The key is staining and not sensitivity....the glaze doesn’t have a thing to do with sensitivity.)

After the provisionals were in place, the patient was encouraged to make note of any possible changes in aesthetics and function that she felt would be necessary to discuss.

Photographs were taken at the post preparation appointment, and models of the provisionals were created (Figures 6 and 7). The patient made some suggestions and underwent another stick bite and a new face-bow to avoid the restorations appearing canted after final seating (Figures 8 and 9). Once the patient was satisfied with the provisionals, all photographs and pertinent diagnostic information was forwarded to the laboratory with a prescription for IPS e.max Press lithium disilicate restorations using the cut-back and layering technique on all teeth.

Laboratory Protocol

After receiving photographs, diagnostic information, and the prescription from the dentist, the ceramist first poured the impressions in stone. Wax then was injected through the matrix of the provisionals onto the master dies (Figure 19). The margins were sealed, and form and function were developed in the wax. Once this was completed, the restorations were ready for investing and pressing with the selected lithium disilicate ingots (Figure 11). The canines and bicuspids were pressed from IPS e.max HTBL2 bleache shade, low value, and the incisors from IPS e.max HTBL1, higher value, for both the uppers and lowers (Figure 12). The lower restorations also were formed through wax injection of the provisional matrix and readied for investing and pressing (Figure 13).

After the restorations had been devested and then fitted on the working model, they were scrutinized against the model of the provisionals (Figure 14). Internal powder effects were added to the stained 0.5-mm incisal facial cutback. Opal white dentin (OE 4) powder was used to create the internal lobes, while light mamelon (MM) created the incisal edge and a natural halo effect (Figures 15 and 16). Segmented low value, high opal (OE1) enamel powders (only 0.5 mm) were added to full contour in the outermost incisal-mesial and incisal-distal, alternating with contrasting high value (T11) powders to mimic natural optical qualities (Figures 17 and 18).

A wax-based red pencil then was used to draw the desired line angles on the restorations, after which the interproximal deflection zones were developed using the flat surface of a diamond-based rubber wheel (9400ZC [KOMET USA]) (Figure 19). The facial lobes were developed prior to imparting the perikymata, each of which were established using a diamond bur (842R [KOMET USA]) to finalize the surface prior to glazing (Figures 20 to 23).

Final Seating

The provisionals were removed and then the preparations cleaned with brushes (ICB Brushes [Ultradent Products]) and a chlorhexidine and hydrogen peroxide antibacterial scrub (Consepsis Scrub [Ultradent Products]) (Figure 24). A retraction barrier (Optragate [Ivoclar Vivadent]) was placed in the patient’s mouth to allow easier photography, patient comfort, and to provide a dry operative field.

The final restorations were placed in the mouth with a try-in cement gel (VarioLink Veneer [Ivoclar Vivadent]) designed for veneers to verify the contacts, fit, and occlusion. The patient was pleased with the appearance of the restorations after viewing them intraorally in various lighting conditions, including natural sunlight.

The restorations were removed to be deep cleaned: the try-in gel and other possible contaminants were removed from the lithium disilicate restorations using a 35% phosphoric acid etch (Ultra Etch [Ultradent Products]) applied for about 20 seconds, and then rinsed with water. All restorations were primed with a ceramic silane primer (Rel-X [3M ESPE]) before placing and air-dried. A fourth-generation adhesive (ALL BOND 3 [BISCO Dental Products]) was then applied on the internal surfaces of the restorations. The restorations were air-dried and set aside in a light-proof container (Vivapad [Ivoclar Vivadent]). It is correct to coat the internal surfaces of the restorations with adhesive.

To ensure proper adhesion, the teeth were completely isolated and etched with a phosphoric acid gel (Ultradent Products). A desensitizing agent (System.desensitizer [Ivoclar Vivadent]) was then applied for 20 seconds each, using high-speed evacuation to remove the excess (Figure 25). Immediately following, the teeth were coated with the fourth-generation adhesive (ALL BOND 3) for 20 sec-
no movement of the adhesive on any of the teeth. A light-cured resin cement (VarioLink Veneer [Ivoclar Vivadent]) (shade +1) was then loaded into the place using the tacking tip of the curing light (Blue Phase [Ivoclar Vivadent]). The restorations were cured in wave-like motions, facially and lingually, for 2 seconds each. Excess cement was then easily removed, and the margins were coated with copious amounts of a glycerin gel (Liquid Lens [Danville Materials]) (to prevent an oxygen inhibited layer from forming) and cured for a full 20 seconds on each side.

To give the restorations their final fit and finish, diamond burs (flame-shaped: FSD4F 010, FS4EF 010, EF4UF 010; pointed-shaped: 8274 016, 274EF 016; and football-shaped: 8379 023, 379EF 023 [KOMET USA]) and a diamond polishing system (Optralight [Ivoclar Vivadent]) were utilized, followed by the use of a diamond polishing paste (Diashine [VH Technologies]). Separating strips (KOMET USA) were used as needed, and the contacts were rechecked for residual adhesive, cement, and smoothness using dental floss. The occlusion was then fine-tuned to develop perfect anterior guidance, and no posterior interferences were noted on the premolars. (Note: The molars remained out of occlusion, however, because they had not undergone restoration at the time this procedure was completed.)

Upon conclusion of the case, the patient, dentist, and dental laboratory team were very pleased with the aesthetic and functional results of treatment (Figures 16 and 27 and After Image). The patient was even more excited that she could wear lipstick for the first time, and have the self-confidence to do so without worrying that it would draw attention to her previously unesthetic smile. For the dentist and ceramist, the case was successful beyond merely the predictably planned dentistry, but rather by making a special and dramatic difference in the patient’s life.

**CONCLUSION**

Although aesthetics is the main goal in the anterior region, the most important aspects of any restoration are the function and stability of the masticatory system. To ensure restorative longevity, dentists must consider the forces that will be placed on their restorations and what affect anterior guidance, vertical dimension, and parafunctional habits will have. From there, they can develop a treatment plan to satisfy the patient’s collective needs using an appropriately selected material.

While this is important for all restorative cases, the authors note the significance of providing predictable, aesthetic, and durable restorations that will function long-term in particular for this patient. She is a kind, warm, and active woman who never liked her smile and, as a result, never wore lipstick. As dental professionals, there is no greater professional or personal satisfaction than the smile on a patient’s face—especially if you are the one who designed it especially for that individual.

By using advanced materials like lithium disilicate to correct functional and aesthetic needs, dentists and ceramists can provide patients with highly functional results—and even more importantly—greater self-confidence through aesthetics. 

**References**


