



How Proper Function Dictates Restorative Success

Repairing functional challenges in an esthetically pleasing smile

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In pursuit of satisfying patients' esthetic demands, harmonious function of the stomatognathic system must not be overlooked. A visually pleasing smile may be temporarily gratifying for a patient; however, if precise restorative parameters are not followed, the equilibrium between hard and soft tissues may be affected, resulting in speech, masticatory, neuromuscular, and deglutition impairment. Stability must be the underlying goal in all decisions regarding tooth placement.¹

Case Presentation

The patient in this case presented with complaints about his recently placed eight maxillary porcelain restorations—six veneers (teeth Nos. 5, 7, 8, 9, 10, and 12) and two full-coverage crowns (teeth Nos. 6 and 11). His comments focused more on a functional than esthetic concern as he reported having difficulty closing his lips over his new teeth and slight interference with his speech. Figure 1 and Figure 2 show a smile that appeared to be

esthetically acceptable with healthy gingival tissues and satisfactory hue, value, and chroma of the restorations. Based solely upon the patient's photographs, there are no changes the authors would make. Fortunately, this meticulous patient had kept an original pretreatment model of his teeth prior to preparation for his current restorations.

Diagnosis and Treatment Planning

To evaluate the changes that were made, a model of the patient's maxillary arch was fabricated to capture the contours of the existing restorations by placing a Sil-Tech Putty (Ivoclar Vivadent, www.ivoclarvivadent.com) matrix over his new front teeth and original posterior teeth. When the matrix was placed over the model of his original teeth, there was

quite a discrepancy (Figure 3). The new restorations were built out facially 3 to 4 mm farther than his original teeth and they were 4 mm longer than his original teeth. It is no wonder he could not close his lips over his new front teeth. The technical term for this problem is violation of lip closure pattern or violation of envelope of function. As teeth erupt, the outward pressure of the tongue and inward pressure of the lips and buccinator-orbicularis oris muscle bands influence their horizontal position and inclination until the opposing forces are equal.² This concept is referred to as the neutral zone. Therefore, any violation of moving teeth outside of this neutral zone defined by the musculature will result in increased pressure against the muscle upon which the tooth intrudes.^{2,3}



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FIG. 1



FIG. 2

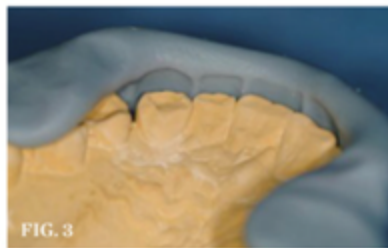


FIG. 3

(1.) Full-face view; patient dissatisfied with his new maxillary restorations from a functional standpoint. (2.) Frontal view showing existing veneers. (3.) A comparison of the existing restorations to the patient's pretreatment model indicated how much longer and wider the new veneers were compared to the original teeth.

Since neutral zone forces develop through muscular contraction during the various functions of chewing, speaking, and swallowing, they vary in magnitude and direction in different individuals.⁴ In a normal eruption pattern, the gingival half of the maxillary incisors forms a straight line with the alveolar crest, and as the mouth closes, the incisal half falls behind the vermilion border of the lower lip (Figure 4). This patient's maxillary incisal edges did not fall behind the lower lip, but rather compressed into the lip (Figure 5). Ideally, the maxillary incisal edge should lightly contact the inner vermilion border when speaking words that begin with the letters "F" and "V"; however, phonetics were impaired due to the excessive vertical length of the restorations that intruded the lower inner vermilion border. A permissive anterior guidance, in which vertical and horizontal overlap are altered so that anterior esthetic change is accomplished within the patient's envelope of function, is essential for functionally successful restorations.⁵ An unfavorable anterior guidance with overcontoured maxillary restorations may produce abnormal and potentially pathologic functional movements of the condyles.^{6,7} According to Dawson, the position of the upper incisal edges is critically important to determine whether an anterior guidance is in harmony with an ideal envelope of function or is interfering with it.² Determination of precisely correct incisal edges is the second most important decision a dentist must make regarding occlusion, with centric relation being the most important.² Both dental and gingival esthetics act together to provide a balanced smile; a defect in the surrounding tissues cannot be compensated by the quality of the dental restoration and vice versa.⁸ Therefore, other issues to address included the need for crown lengthening on teeth Nos. 5 and 12 to achieve a more balanced gingival zenith.

The authors' plan was to replace the eight maxillary restorations with the Authentic[®] pressable ceramic system (Jensen Dental, www.jensendental.com) using the Authentic[®] B00+ ingot (Jensen Dental) for all-ceramic crowns for teeth Nos. 4 through 7 and Nos. 10 through 13, veneers for teeth Nos. 8 and 9, and two Authentic[®] Pressable to Galileo high noble (Jensen Dental) porcelain-fused-to-metal (PFM) crowns for teeth Nos. 3 and

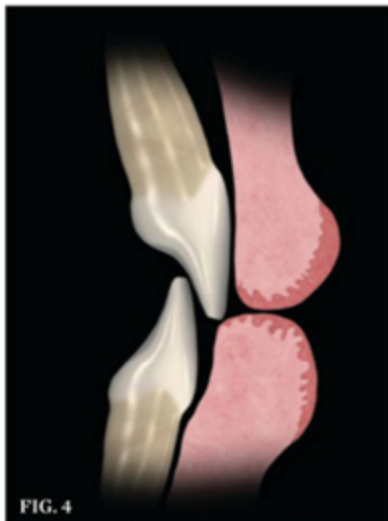


FIG. 4

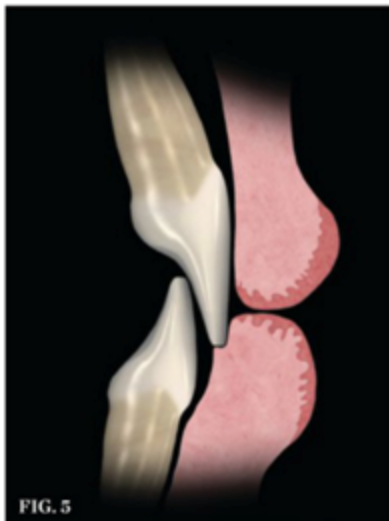


FIG. 5



FIG. 6



FIG. 7

(4.) As the mouth and lips close, the incisal one-half of the incisors tucked behind the vermilion border of the lower lip. (5.) Violation of lip closure pattern with maxillary incisors compressing into the lower lip. (6.) The Wynne 2000 occlusal plane analyzer adapter for the SAM[®] 3 articulator allows for fabrication and verification of proper placement of the curve of Spee. (7.) Right lateral view of proper curve of Spee, created by the Wynne 2000 occlusal plane analyzer.

14. Twelve mandibular teeth were prepared and the same porcelain and PFM system and ingot selection was utilized. Four all-ceramic crowns (teeth Nos. 20, 21, 28, and 29), two PFMs (teeth Nos. 19 and 30), and six veneers (teeth Nos. 22 through 27) were treatment planned to obtain a more uniform color appearance. The Authentic pressable system was selected due to its strength, superior optical properties, and conservative prep design. According to the manufacturer, Authentic is the strongest pressable ceramic material in the leucite-reinforced pressable category and offers 58 different fluorescent pressable ingots in a range of opacities, which increase vitality to resemble the natural dentition in all lighting sources.⁹

Clinical Protocol

After an extensive diagnosis of this patient's functional and esthetic needs, the decision was made to first perform crown lengthening on teeth Nos. 5 and 12 and then treat the mandibular teeth. Restoring the mandibular teeth prior to the maxillary teeth would allow an opportunity to establish the proper plane of occlusion and curve of Spee by utilizing the Wynne 2000 adapter for the SAM[®] 3 articulator (Great Lakes Orthodontics, www.greatlakesortho.com) (Figure 6). This occlusal plane analyzer identifies on the flag atop the articulator the intersection of two 4-in arcs. One arc's center originates at the incisal tip of the mandibular canine, with the other arc's center originating from the most distal cusp of

the last mandibular molar. From the point of intersection of the two 4-in arcs, a new 4-in arc's center will touch the cusp tips of the premolars and molars, indicating any necessary shortening or lengthening of cusps to form the proper curve of Spee (Figure 7). This necessary step allows harmony to exist between the anterior teeth and condylar guidance by eliminating excursive interferences and obtaining a more predictable occlusal relationship.¹⁰

A properly waxed mandibular model was used to create an axial reduction matrix for the mandibular arch, as it is easy to use and provides the proper form for the preparation at different heights. The preparation of the mandibular arch required 0.8 mm of facial reduction and 1.5 mm of incisal reduction of the six anterior teeth. A 0.5-mm depth cutting diamond (Maxima Diamond No. 9000-7136, Henry Schein Inc., www.henryschein.com) was used, followed by a 0.3-mm depth cutting diamond (Maxima Diamond No. 9000-7135,

Henry Schein) for a total of 0.8 mm of facial reduction. Each depth cut was identified with an indelible marker to ensure the exact amount of tooth structure was removed with the round-ended diamond No. 112-5161 (Henry Schein). As a 1.5-mm incisal reduction was desired in this case, the authors sank a 0.75-mm diameter diamond bur twice its diameter to get the desired reduction. A diamond shank (8878K.31, Brasseler USA, www.brasselerusa.com) was utilized to clear the contact areas and smooth all external line angles. By preparing the teeth with cleared contacts, several advantages are gained:¹¹

- Technician is provided with control over placing and correcting misaligned midlines.
- Alterations in color can be made in this area to mimic natural teeth.
- Lingual margin is placed in a free cleansing area.
- Retention form is increased.

The mandibular arch was completed with the proper occlusal plane and curve of Spee. After 8 weeks of healing time following crown lengthening surgery of teeth Nos. 5 and 12,

preparation of the maxillary arch began the day after delivery of the mandibular arch. An axial reduction guide and incisal edge Sil-Tech Putty matrix of the original maxillary teeth directed the preparations in a similar manner as the mandibular preparations. The authors used the acid-etch technique to bond the restorations in place. The preparations are etched with Etch-Rite™ 38% phosphoric acid gel (Pulpdent, www.pulpdent.com) for 20 seconds, washed thoroughly, and dried, followed by placing several coats of Dentin Desensitizer (Pulpdent). Several coats of OptiBond™ FL (Kerr Corporation, www.kerrdental.com) primer were then applied, followed by one coat of adhesive. These coats were slightly air dispersed, then light cured for 20 seconds. The restorations were cleaned with Ivoclean (Ivoclar Vivadent) for 20 seconds, rinsed, and air-dried; then one drop of Silane Primer (Kerr Corporation) was placed and air dispersed. Final cementation was completed with Calibra™ Esthetic Resin Cement (DENTSPLY Caulk, www.dentsply.com).

Proper finishing of restorations is essential for gingival health and long-term case success.



FIG. 8



FIG. 9



FIG. 10

(8.) Frontal view showing completed case.
(9.) Frontal view demonstrating properly contoured maxillary restorations and improved color.
(10.) Full-face view of completed case.

Restorative

Three burs were used to initiate the finishing process. First, a red-stripped 30-grit diamond (Brasseler) was used around all margins, followed by a yellow-stripped 15-grit diamond (Brasseler), and then a white-stripped 30-bladed finishing bur (Brasseler). Next, Shofu polishing points were used, starting with the no-stripe point, then the yellow-stripped, and lastly, the white-stripped polishing point (Shofu, www.shofu.com). The interproximal finishing began next using a Cerisaw™ (DenMat, www.denmat.com) to first clear out excess cement in the interproximal areas, then a red-stripped Gateway flex diamond strip (Brasseler) was utilized to smooth each interproximal surface. The last and most significant interproximal polishing was with the series of Epitex® finishing strips (GC America, www.gcamerica.com). After the blue, green, gray, and tan strips were used, flossing between the teeth was extremely smooth, and the polishing sequence was complete. A functional and esthetic improvement was

achieved with the new restorations (Figure 8 through Figure 10).

Conclusion

This patient's case presented a functional challenge that was not evident at first glance. Listening to this patient's chief complaint and comparing pre- and post-treatment models identified the functional dilemma. The authors were able to address the lip closure issues and violation of envelope of function as well as improve gingival zenith and coloration. All involved in this case were pleased with the final results.

Disclosure

William P.D. Wynne, DDS, is the creator of the Wynne 2000, which is sold by Great Lakes Orthodontics.

Acknowledgment

Laboratory fabrication by John Wilson of Wilson Dental Arts.

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