Restoring Aesthetics and Function

A Bioesthetic-Based Approach

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INTRODUCTION

With an increased awareness of the effects that dentistry can have on self-confidence, self-image, and self-esteem, today's patients come to the dental office seeking treatments beyond simple whitening procedures and diastema closures.[1] Patients now desire alteration of tooth size, proportion, and position that compliment their smile and overall facial appearance.[1] However, in order to create harmony between facial and functional structures, clinicians must consider principles of Bioesthetic dentistry that enable objective and subjective assessment of the patient's condition and subsequent development of a comprehensive, multidisciplinary treatment plan.[1]

Bioesthetic Dentistry

Pioneered by Dr. Robert Lee, and defined as the study or theory of the beauty of living things in their natural form and function, Bioesthetic dentistry requires a complete evaluation of various aspects of the patient's oral cavity and facial structures including expressions, eyes, posture, and the aging process.[2,3] To fully grasp this approach, it is therefore necessary for dentists to observe these components as a single, collective unit.[3] Overall, proper and successful long-term success of restorative dental treatment depends upon the cohesive relationship between the anterior and posterior dentition, the temporomandibular joint (TMJ), and the neuromuscular system.[3] Specific to each individual case, treatment may address the entire collective structure, a single unit within the structure, or several units contained within the whole.[3]

Bioesthetic Protocol

Bioesthetic dentistry encompasses 3 main components: form of the occluded dentition, form of the joints, and form of the teeth.[4] Highly functional and aesthetic restorative results demonstrate harmony among the interrelationships between function and objective aesthetics.[4] In general, the goals of Bioesthetic dentistry include maximizing the anterior guidance and making the posterior segment vertical, which minimizes the influences of condylar guidance on the morphology of the posterior teeth.[4]

Before Image. Preoperative photograph of the patient.

After Image. Postoperative photo of the patient's dentition and facial features shows how the mandibular alignment and anatomy of the restorations created a highly aesthetic and functional result.

To achieve the proper occlusal scheme, which is a significant objective of the Bioesthetic concept, the appropriate axial inclination of the anterior teeth along with the correct horizontal and vertical overlap; 2.0 mm to 3.0 mm and an overbite of 4 mm to 5 mm, according to the literature, must be developed to facilitate guidance of the posterior teeth with the condyles in centric relation (CR).[4,5] Defined as any place along the arc of closure where the condyles are bilaterally in their most superior, anterior, and medial position and in intimate contact with the thinnest part of the biconcavity of the disk, CR is used to restore vertical dimension.[4]

Only when posterior optimal biologic tooth form is properly established and achieved by appropriate anterior guidance can elevated levels of temporal and masseter muscle activity be reduced.[4] Important to note: it is not the contact of the canines that decreases the activity of the muscles.[4] The actual cause of this decreased activity is elimination of posterior eccentric contacts.[4]

Additionally, Bioesthetic dentistry cites length of the dentition in its principles as a key to successful, healthy, and aesthetically pleasing restoration of the masticatory system.[5] The study of hundreds of healthy stomatognathic systems have yielded certain averages for teeth length, vertical dimension of occlusion (VDO) in both the molar and anterior areas, horizontal and vertical overlaps, and the ideal occlusal plane. These measurements are biological parameters, which need to be closely assessed with every individual case as passive eruption and supra-eruption of teeth, as well as variable curves of Spee, need to be accounted for. Once these parameters have been evaluated and the lengths determined, the aforementioned overbite and overjet measurements must be accounted for.[5] It is important to note that while the above averages have been observed and studied in healthy dentitions, they are used only as guidelines.

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Figure 1. Close-up image of the patient's smile, showing worn dentition and improper guidance.

Figure 2. Preoperative left and right side views of the patient's smile and worn dentition.

Figure 3. Full-retracted view of the patient's dentition showed extreme wear and some gingival recession.

Figure 4. The patient complained of prior restorative work that was breaking down.

Figure 5. Using a caliper, the upper central incisors were measured and found to be 7.0 mm in length.

Figure 6. The lower canines were found to be 10.0 mm long.

Figure 7. Cemento-enamel junction (CEJ) to CEJ (tooth No. 8 to tooth No. 26) measurement was found to be 15 mm.

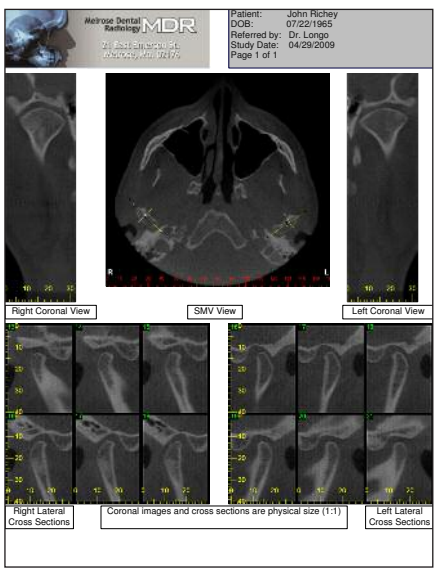

Figure 8. Three-dimensional cone beam scan was taken without the maxillary anterior-guided orthosis (MAGO) (bite splint) in place.

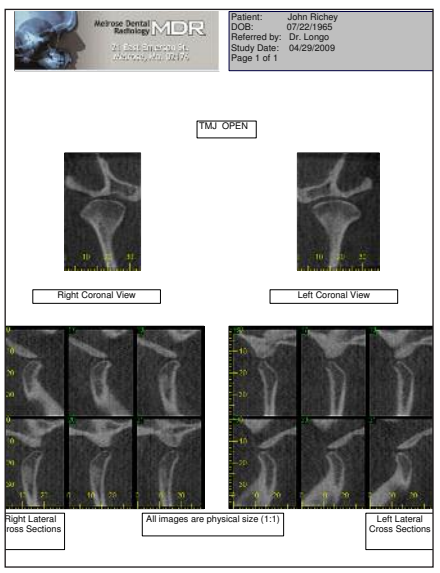

Figure 9. The initial cone beam scan demonstrated that the condyles had been reduced along the posterior superior surfaces, and the posterior surfaces of the condyles showed signs of flattening and sclerosis, and signs of regressive remodeling through function.

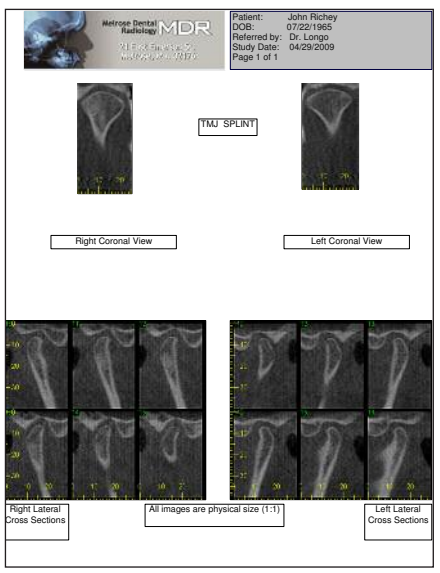

Figure 10. Next, a cone beam scan was taken with the MAGO (bite splint) in place, showing the condyles were nearly centered within the fossa, the intra-articulator space was mostly even throughout the fossa, and that the condyles were healthy overall.

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Alternatively, the use of the maxillary anterior-guided orthosis (MAGO) allows the stomatognathic system to reach stability (ie, muscles in their rest position free of pain; the condyles centered in the fossa; and the joints properly loaded and free of inflammation). Once stable, it is then necessary to identify the specific axis of rotation of the mandible. Using a MAGO, or a splint, facilitates these determinations. When the stomatognathic system is in good health, the MAGO therapy is the splint used that allows the dentist to begin to develop accurate functional planes that result in a true orthopedic relationship between the cranial base and the mandible.

Although these guidelines can be used as dependable markers, they are not completely accurate for each individual case.[5] It is by applying them within the context of bioesthetic principles that a functional template of the stomatognathic system can be created, leading to long-lasting and durable restorations that require minimal dentistry after placement.

Conditions of the Masticatory System

When considering the principles of Bioesthetic dentistry, it is necessary to first understand the many conditions with which a patient may present.[5] Individuals requiring bioesthetic treatment often show symptoms that include cracked teeth, tooth wear, tooth abfractions, joint pain, muscle pain, and headaches.[5] Found not to occur in isolation, these symptoms can be traced to the relationship between the jaw and teeth. When the symptoms do not respond to conventional treatment modalities, dentists must consider the way the masticatory system is functioning and what effect it may have on the patient's overall condition and health.[5]

One condition of the TMJ affecting nearly 8 to 21% of the population, bruxism is characterized by clenching and/or grinding the dentition caused by repetitive jaw muscle contraction and occasional tooth grinding sounds.[6-8] Bruxism has been linked to poor biomechanics of the jaw.[9] Patients afflicted by this condition often suffer from jaw muscle/joint pain, headaches, tooth sensitivity, and excessive tooth wear.[6] The greater the discrepancy between the cranial base to the mandibular position, the greater the transverse or horizontal movements of the mandible and the greater the symptoms of TMJ.[9]

CASE REPORT

Diagnosis and Treatment Planning

A 44-year-old man presented with a chief complaint of worn teeth, as well as bonded restorations and fillings that were continually breaking down (Before Image). The patient's dental history consisted of prior orthodontic treatment that had included the extraction of all his first premolars. He also presented with an extensive history of fillings and central incisors that had been broken in the past and, therefore, required multiple bonded restorations. Recurrent pericoronitis in the area of tooth No. 32 was obvious and, overall, the patient's dentition was extremely worn (Figures 1 to 4). However, there were no prior root canals, crowns, or onlays.

The patient was in constant interaction with others. Caring greatly about his recurrent broken fillings in the anterior area, as well as the premature failure of his posterior restorations, the patient became interested in rebuilding his bite.

Based on an understanding of Bioesthetic dentistry and experience in restoring severely worn dentition using flowable composites, crowns, and a combination of both, the author felt confident in restoring the patient's full upper and lower arches.

Based on the conditions with which the patient presented, a bioesthetic treatment plan would be developed and carried out to not only

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correct the tooth wear, but also prevent future damage to the dentition. Acknowledging the forces that had destroyed the enamel and dentin, the patient was placed on MAGO therapy and observed. By following the principles of the bioesthetic philosophy, it was felt that a predictable outcome, which would provide proper function and excellent aesthetics, could be achieved, thus fully satisfying the patient's personal goals and desires.

Further examination of the patient revealed that all intraoral and extraoral soft tissues were within acceptable limits. The patient presented good oral hygiene, with probings all within normal range. There was no history or present incidences of periodontal disease, but the patient did demonstrate generalized gingival recession. Excessive wear of the tooth structures was clear, and abfractions were present. There was no existing clearance during anterior guidance, and CR was not equal to centric occlusion (CO). As a result, the first point of contact in CR was tooth No. 14, with a 3-mm slide anteriorly into CO.

After examining the oral cavity and tissues, the patient underwent joint and muscle examinations to determine the state of his TMJ function. A joint load test was given initially, which resulted in a negative finding. The joints also were quiet when auscultated at rotation and translation. When opening and closing, there was no deviation. The patient did not experience muscle discomfort or tenderness, and there was no capsulitis or ligamentitis present.

Measurements were taken to further evaluate the amount of tooth structure lost from wear. The upper central incisors were measured from the incisal edge to the cemento-enamel junction (CEJ) and found to be 7.0 mm in length, which is 5.0 mm less than the biologic average of 12.0 mm (Figure 5). The patient's lower canines were then measured and found to be 10.0 mm, which is below the range that they should fall within (ie, 11.0 to 15.0 mm and the average of 12.0 mm) (Figure 6). The distance from the upper CEJ to lower CEJ (measured between tooth No. 8 to tooth No. 26) was 15.0 mm (Figure 7). Typically this measurement would range from 18.0 to 20.0 mm in the average oral cavity, assuming there has been no passive eruption.

After these measurements were completed, the patient underwent a 3-dimensional cone beam volume scan (closed) without the MAGO (bite splint) in place (Figure 8). The results demonstrated that the condyles had been reduced in size along the anterior superior surfaces, and that the anterior surfaces of the condyles showed signs of flattening and sclerosis (Figure 9). These conditions, which are signs of regressive remodeling, were most likely directly caused by the functional demands placed on the dentition from bruxing.

An additional cone beam volume scan (closed) also was completed with the MAGO in place (Figure 10). A special bite splint that is worn at all times (24/7) and continuously adjusted to seat the condyles, properly load the joints, and to allow muscles to find their at-rest position, the MAGO was necessary to find the patient's CR. Immediately changing the facial expression of the patient by releasing the stress of the muscles and increasing the VDO, the splint provided the unique ability to bring temporary alignment and harmony to the jaw joint and muscles (Figures 11 and 12). It is important to note that the MAGO was used *only as a diagnostic tool.*

With the MAGO in place, the scan results showed that the condyles were nearly centered within the fossa, and that the intra-articular space was most-even throughout the fossa. Overall, the condyles were healthy, with good cortication and deep fossae, but both had undergone some remodeling. These characteristics were viewed as benefits for vertical chewing and a stable restorative case.

When the position of the jaw appeared stable, a CR checking device, referred to as the Apical Positioning Indicator (Panadent), was utilized to validate condylar stability (Figure 13). The functional plane of occlusion (ie,

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Figure 11. The patient's MAGO.

Figure 12. The MAGO immediately changed the patient's facial expression by releasing stress from the muscles and increasing the vertical dimension of occlusion.

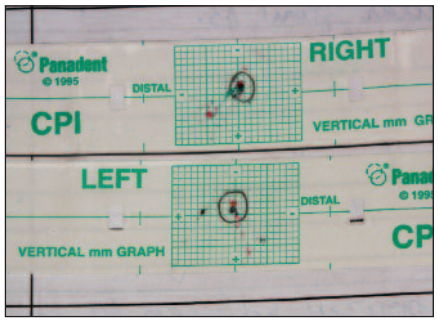


Figure 13. An Apical Positioning Indicator (Panadent) was used to confirm the stability of the condyles.

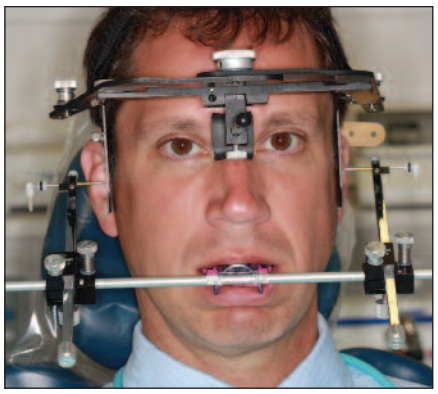
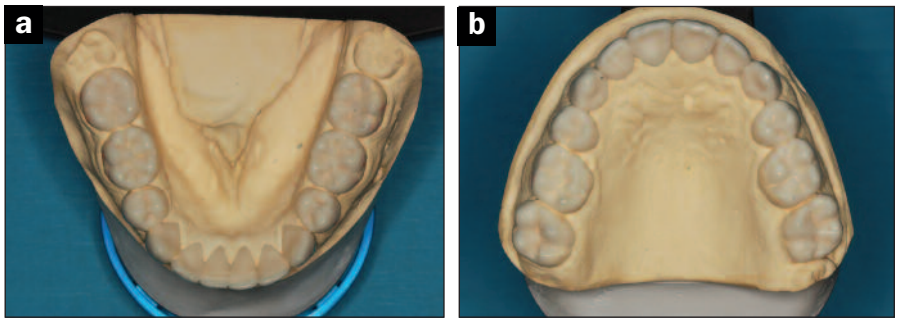


Figure 14. The hinge axis of the mandibular rotation was recorded using the Axi-Path system.



Figures 15a and 15b. A wax-up was created by the dental laboratory team for the clinical placement of provisionals.

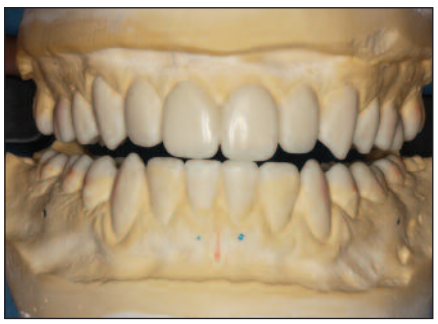


Figure 16. Before being sent back to the clinician's office, the wax-up was checked for proper form and function.

Figure 17. Prior to the placement of temporary restorations, chamfer preparations were done.

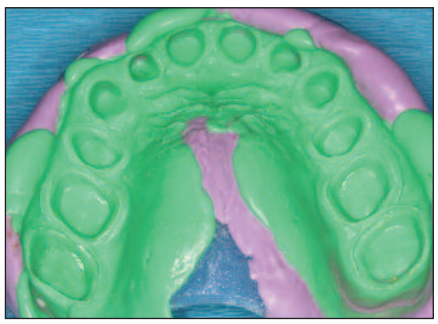
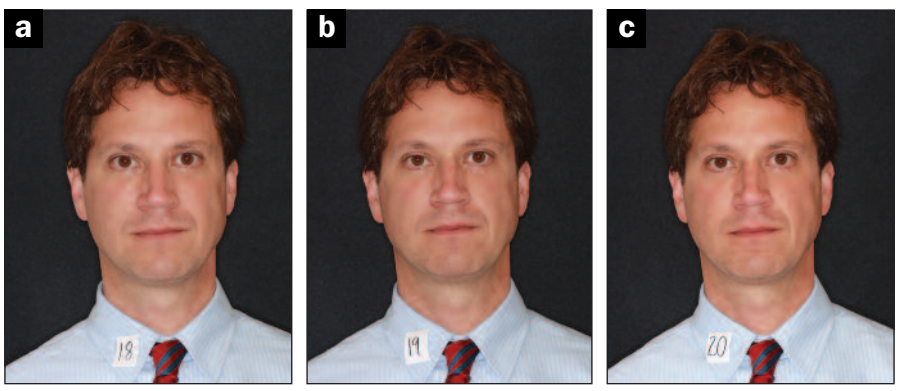


Figure 18. Provisional restorations were made chairside with a self-curing crown and bridge resin (Exacta Temp [EXACTA Dental]). Final impressions of the temporary restorations were taken and sent to the laboratory.



Figures 19a to 19c. With the provisional restorations in place, the relationship between facial appearance and the ideal vertical dimension was clear.

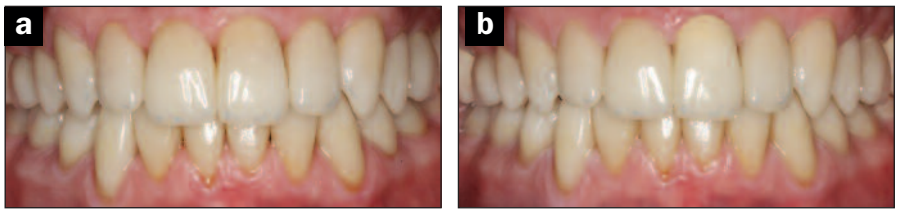
Figure 20. The completed upper definitive restorations were hand-crafted using a lithium disilicate (IPS e.max Press [Ivoclar Vivadent]) glass ceramic.

Figure 21. Completed lower crowns, shown on the working model.

Figure 22. Lower crowns were tried-in.

Figure 23. Upper crowns were then tried.

Figure 24. Using an 8-µm shim, occlusion (and uniformity) was confirmed.



Figures 25a and 25b. Before and after images of the patient's dentition, showing extreme wear corrected through the use bioesthetic principles and pressable lithium disilicate crowns.

Figure 26. Close-up smile after restorative work was completed.

Figure 27. After the restorations were placed, the mandibular alignment, a key factor in the aesthetic outcome, was corrected.

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the relationship between the arches when the mandible is at its most stable position) was used to restore the case. Additionally, to record and evaluate the hinge axis of mandibular rotation, a pana-digit jaw movement recorder and tracing paper (Axi-Path [Panadent]) was used (Figure 14).

After undertaking all diagnostic steps required in the Bioesthetic dentistry model, it was determined that the main cause of the accelerated wear the patient presented with was a cranial base to mandibular discrepancy.

In this particular case, it was decided that since there was extreme wear to the dentition, full upper and lower crowns would be the treatment of choice. It was decided that all the third molars would be extracted. Temporary restorations would be placed first to allow evaluation of function and aesthetics, followed by laboratory-fabricated definitive restorations. All 24 teeth would be restored with crown restorations fabricated using a pressable lithium disilicate all-ceramic (IPS e.max Press [Ivoclar Vivadent]).

Laboratory Wax-up

After receiving the case information and specifics from the clinician, the dental laboratory team waxed the case according to the bioesthetic philosophy. The initial impressions were duplicated and then mounted. The first set was mounted on the functional plane of occlusion (FPO), and the second set was mounted on the aesthetic plane of occlusion (EPO). The FPO is the plane recorded using the hinge axis. It is the true orthopedic relation between the maxilla and the true hinge axis of the chondyles. As some maxillary planes are not consistent with the horizon as required by the smile/aesthetic zone, the EPO or face-bow transfer record is needed.

The VDO of occlusion in the articulator was established by the clinician prior to the FPO mounting, after which the final wax-up was completed on the EPO mounted models. When the final wax-up was completed, it was returned to the dentist, along with jigs and matrices, in order to accurately take the wax-up from the model to the mouth.

Incorporating the bioesthetic principles of anatomy and occlusion provided harmonious function of the entire stomatognathic system (Figures 15 and 16).

Provisional Restorations

After the laboratory wax-up was received and placed intraorally, the anterior teeth underwent a chamfer preparation, and chairside provisional restorations were created using a self-curing crown and bridge resin (Exacta Temp [EXACTA Dental]), with the wax-up used as a guide (Figures 17 and 18). The posterior teeth were then prepared in the same way, in separate segments, except for the most posterior teeth of each sextant in order to provide accurate transfer of the temporary material. Lastly, the most distal molars were prepared and temporized with a bis-acryl provisional material (Exacta Temp). The occlusion of the temporary restorations was then evaluated, and any corrections/adjustments deemed necessary were made.

Close attention was given to the occlusal scheme and the anterior guidance at this point in treatment. The temporary restorations were periodically checked for stability and wear. Additionally, condylar stability was evaluated once again using the Apical Positioning Indicator. Impressions were then taken after the patient and clinician were satisfied with the function and aesthetics of the provisional restorations (Figure 19). To choose the ideal vertical dimension in CR, function and facial appearance should be the definitive guide, assuming that the intraoral relationship between the arches is within bioesthetic parameters (Figure 20). After the provisional restorations were evaluated, the impressions were sent to the laboratory, along with the functional plane and aesthetic plane (face-bow) record.

DEFINITIVE RESTORATIONS

Following the principles of bioesthetics, the lithium disilicate crowns were designed in the laboratory with an understanding of nature and of the optimal health model, which incorporated form of the joint, form of the occluded dentition, and form of the teeth. The hand-crafted pressable lithium disilicate glass ceramic (IPS e.max) crowns were created for all 24 teeth to facilitate proprioceptive guidance (Figures 21 and 22). A cutback with internal essence stain was used, in addition to a multilayering technique. Each occlusal contact was adjusted to an 8 µm tolerance.

FINAL CEMENTATION

Initially, the case was received from the laboratory for a bisque bake try-in. During this stage of treatment, every crown was evaluated for marginal fit and occlusal contacts. The anterior crowns were placed first, followed by the posterior crowns (Figures 23 and 24). Once it was determined that all crowns fit well and occlusion was correct, the crowns were cemented into place.

To help the condyles remain in their proper place, a specific cementation protocol was followed. Using a resin cement (Rely X Unicem [3M ESPE]), the restorations were bonded into place. Then, the occlusion was checked again with an 8-µm shim to confirm uniformity throughout (Figure 25). A small deprogrammer was then used overnight, then, the following morning, the occlusion was checked again. It is important to note that during the first year that the restorations are in place, they should undergo peri-

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[illegible] adjustments as needed. Doing so will increase the longevity of the case, since it is dependent on the relationship between the anterior teeth, the condyles, and the closely sculpted anatomy between all teeth within the arches.

Overall, the mandibular alignment, the form of the teeth, and their combined function were the keys to the high aesthetic outcome of the case (Figures 26, 27, and After Image).

CLOSING COMMENTS

Through objectively and subjectively assessing the patient's features and masticatory system, the clinician and the dental laboratory technician were able to provide the patient with highly aesthetic and functional restorations according to the well-established principles of Bioesthetic dentistry. Undertaking proper evaluations, diagnostic protocols, and utilizing a multidisciplinary approach, an overall harmony was created between the dentition and the patient's appearance. By creating a cohesive relationship between the anterior and posterior dentition, the TMJ, and the neuromuscular system, a long-lasting and well-functioning reconstruction was completed for our patient.✦

Mr. O'Rourke, a certified dental technician, graduated from the New England School of Mechanical Dentistry in 1982. He opened his own laboratory in 1984. Mr. O'Rourke has spent 3 decades focusing on continuing his education, including receiving his certificate in dental technology with a discipline in ceramics in 1997. He graduated from the Dawson Center for Advanced Dental Studies in 2001 and in 2003, he attended the Schuster Center for Professional Development with a focus on patient case presentation. During the last 10 years, he has studied with the Foundation for Bioesthetics and was named to the faculty in 2011. He is also a faculty member and codeveloper of Integritas, a multidisciplinary educational program involving oral surgery, orthodontics, general dentistry and dental technology. He can be reached at ceramist4u@msn.com.

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