FULL-MOUTH MULTIDISCIPLINARY RESTORATION USING THE BIOLOGICAL APPROACH: A CASE REPORT
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Bioesthetic dentistry is a conservative approach for the restoration of the teeth to natural form and function. This concept generally requires the examination of the patient’s mouth, lips, smile, and face as a single collective structure rather than individual units. Harmonious long-term function depends upon the cohesive relationship between the anterior and posterior dentition, the dentogingival complex, the temporomandibular joints, and the neuromuscular system of the patient. This article defines the role of each of these elements and demonstrates their rehabilitation through a unified multidisciplinary treatment plan.

Key Words: bioesthetic, occlusion, centric relation, vertical dimension, function

Lee once stated that “Bioesthetics studies the beauty of living things in their natural forms and functions.” The success of functional and aesthetic dentistry depends on the clinician’s understanding of natural tooth morphology, tooth position, gingival contours, and the influence of these elements on the dental, facial, and dentofacial complexes. This article discusses the concept of bioesthetics, the interdisciplinary approach in dentistry, and the relationships between function and aesthetics. Use of these concepts allows the clinician to provide restorative care that is both functional and aesthetic.²⁴

Dental bioesthetics examines the relationship of the dental, facial, and dentofacial complexes in order to restore oral defects to natural health and function (Figures 1 and 2). The functional goal of bioesthetic dentistry is to maximize anterior guidance and verticalize the posterior segment with the normal physiologic position of the condyles in centric relation (CR) (Figure 3). This anterior guidance will allow the development of natural (ie, sharp) posterior crown forms without eccentric occlusal interferences (Figure 4), thereby minimizing the influence of condylar guidance on the morphology of the posterior dentition.

Investigators have noted that the elevating activity of the temporal and masseter muscles can be reduced only when posterior disclusion is obtained via appropriate anterior guidance. These clinicians believed that the elimination of posterior eccentric contacts — rather than the contact of the canines — decreases the activity of the elevator muscles.⁵ The occlusal scheme is accomplished through the proper axial inclination of the anterior teeth and through the correct horizontal overlap of 3 mm and

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Figure 1. Preoperative view of patient with compromised dental and gingival aesthetics that must be corrected for a balanced, harmonious appearance.
vertical overlap of 4 mm (Figure 5). This occlusal scheme facilitates the guidance of the posterior teeth with the condyles in CR or acquired.

Centric relation may be defined as any place along the arc of closure where the condyles are bilaterally in their most superior, anterior, and medial (SAM) position in intimate contact with the thinnest part of the biconcavity of the disc (Figure 3). Like CR, the creation of the proper vertical dimension of occlusion is critical to bioesthetic success. The determining factors are the lower one third of facial height and verticalization of the posterior teeth, which often involves cusp restoration. The positioning and design of the anterior segment and its relationship to the posterior segment will enhance this premise.

**Facial Complexes**
Clinicians have been termed “hard tissue plastic surgeons.” Mock believed that the occlusal plane was the determining factor for the restoration of proper facial height. He stated, “When the functional and aesthetic requirements of the occlusal plane and craniofacial balance are restored, the vertical dimension becomes a dynamic concept providing the dentist the opportunity of providing facial beauty beyond mere restoration of the dentition.” The face is thus significantly changed by the alteration of the vertical dimension and the development of the appropriate symmetry.

Dalhl's study, conducted over a period of 5 to 8 years, indicated that increases in occlusal face height of 1.8 mm (mean) were well tolerated and did not result in rapid return to basis. No relapse occurred in any of the cases, which were followed for an average of 5.5 years.

**Case Presentation**
A 41-year-old female patient presented with missing teeth #2, #4, #7, #10, #13, #15 through #21, and #30. The patient's chief complaints included the appearance of the incisal embrasures between the maxillary central incisors, the maxillary crowns at the gingival margins, and the partial mandibular denture. Comprehensive radiographic examination was performed and — other than the appearance of the anterior gingival heights and the crestal widths of the ovate pontics — no significant pathology was determined. A complete series of color photographs, 3 × 5 orthodontic series, centric bite record, tomographic and cephalometric films, and axi-path recordings were also documented (Figure 6).
all existing crowns on the maxillary and mandibular teeth had to be replaced and implants would be inserted, the team decided to establish optimal gingival contours and bioesthetic occlusion in CR. They also decided to reestablish the vertical dimension in order to restore the patient to facial harmony. The neuromusculature system had to be harmonized with the temporomandibular joint (TMJ), and it would be necessary for CR to coincide with centric occlusion (maximum intercuspal position).\textsuperscript{17}

**Pretreatment Phase**

Each member of the restorative team consulted with the patient to provide a detailed description of the treatment. An aesthetic evaluation of the patient’s entire craniofacial complex was also performed at this time to ascertain the relationship of the craniomaxillary segment to the lower third of the face according to the “Golden Proportions.” This guideline was one of the factors that guided the team’s determination of the patient’s proper vertical dimension.\textsuperscript{\textasciitilde,18} While these proportions have been discounted by some authors,\textsuperscript{19} they proved valuable as general aesthetic principles.

A maxillary anterior-guided orthosis was prepared and comfortably worn by the patient for 2 weeks until CR was achieved with no clinical indications of TMJ dysfunction (Figure 7).\textsuperscript{10} This mandatory procedure was necessary to allow the condyles to assume their most SAM position in intimate contact with the thinnest part of the biconcavity of the disc. It permitted the entire TMJ complex to attain improved functional health and allowed posterior avoidance patterns of occlusion to wane and a new vertical dimension to be established. The procedure also ensured that the diagnostic measurements of condylar movements and CR were accurately recorded, and provided training in anterior-guided mastication cycles.\textsuperscript{1} Stable condylar position was verified with a new centric record 1 and 2 weeks postoperatively.

A diagnostic waxup was completed on a set of study models (Figures 8 and 9),\textsuperscript{\textasciitilde,21} which were mounted in CR following orthotic therapy. According to Rickett’s golden divider,\textsuperscript{8} which uses the distance from lateral canthus to stomatic (1.618) and stomatic to menton (1.0) as references, the desired vertical dimension was estimated...
to be 18 mm from the maxillary CEJ to the mandibular CEJ. This design would subsequently be verified by the provisional restorations.22

The following treatment plan was established by the restorative team. In the maxillary arch, periodontal and orthodontic therapy was instituted for teeth #3 through #5, #6 through #11, and #12 through #14. Fixed partial dentures were fabricated for these spans utilizing PFG alloy crown preparations. In the mandible, two implants (Brånemark, Nobel Biocare, Yorba Linda, CA) were placed in the sites of teeth #19 and #21. To enhance the emergence profile of these restorations, angled abutments (UCLA, Nobel Biocare, Yorba Linda, CA) were utilized with the implants. The implant segment replaced teeth #19 through #21 (Figure 10). Single PFG crowns were placed on teeth #22 through #28. A PFG fixed partial denture was fabricated for teeth #29 through #31.

Provisionalization
The gingival marginal crest of the maxillary anterior was contoured, and the tissue was augmented from the palate to enhance the site for the ovate pontics in the sites of teeth #7 and #10. Teeth #5, #8, #9, #12, and #14 were orthodontically repositioned to change the shape of the periodontium. This dynamic biological transformation required approximately 4 months (Figure 11). Teeth #6, #8, #9, #11, and #22 through #27 were prepared without bevels for crowns with shoulder margins apical to the gingival crest. Teeth #2, #5, #12, and #15 were also prepared with shoulders superior to the gingival crest. The maxillary provisional restorations were fabricated in occlusion with the mandibular teeth; while this created a reverse curve of Spee, it enabled the patient to masticate on the unprepared mandibular teeth. The mandibular teeth #28, #29 and #31 were prepared and provisionalized utilizing the same procedure.

Following a period of 4 months, the anterior provisional fixed partial denture was removed and ovate pontics were created in the sites of teeth #7 and #10. An elliptical-shaped concavity was created in the gingival tissue (Figure 12). Acrylic was added to the gingival
Final Preparation

To develop the dentofacial complex, the patient was photographed with lips in repose, at natural smile, and at full smile. The maxillary and mandibular provisional restorations were removed, the crown preparations on teeth #6, #8, #9, #11, and #22 through #27 were redefined, and bevels were placed to provide an ideal marginal seal. The provisional restorations were removed from the posterior teeth. An ear-bow measurement was taken in order to mount the maxillary teeth on an articulator (Panadent Corporation, Grand Terrace, CA), and a closed bite centric record was taken to mount the models. A Boley gauge was used to measure the 18 mm distance — the vertical dimension of occlusion with the centric bite in position. The occlusal vertical dimension was recorded at 18 mm by the centric record; it was not altered on the articulator. Since the vertical dimension had not changed, the closed bite centric record mounting did not require a hinge axis recording.

Color photographs were forwarded to the laboratory with the mounted articulator and appropriate collateral data. The crown restorations were fabricated on the articulator at CR occlusion and the 18 mm vertical, condylar angle, and Bennett settings. The maxillary central incisors and canines were both approximately 12 mm in length; the mandibular central and lateral incisors approximated 10 mm in length, and the mandibular canines were 12 mm. The length of the maxillary area of the provisional fixed partial denture to establish an emergence profile for the pontic (Figure 13). The marginal gingival tissue was developed on the long axis of the lateral incisor pontics and 1 mm lower than the marginal gingival tissue for the central incisors and canines.

The patient wore the provisional restorations for an additional three months to ensure the stability of occlusion, allow final soft tissue healing, and facilitate post-orthodontic bone stabilization. When the occlusion was evaluated, the provisional or crown restorations on the mandibular canines were always removed first in order to develop posterior guidance by analysis of the second cuspid guidance (first premolar), third cuspid (second premolar), and fourth cuspid (first molar) (Figure 14).

Figure 11. Facial view demonstrates orthodontic closing of the maxillary diastema in conjunction with Levine's grids for the "Golden Proportion."

Figure 12. The edentulous ridges were augmented with connective tissue from the palate, and the ovate pontic receptor sites were prepared with a coarse spherical diamond.

Figure 13. Provisional restorations were used to evaluate the new vertical position, functional objectives, and aesthetic considerations. They were refined to develop the ovate receptor sites.
lateral incisors was determined in conjunction with the mandibular canines in order to guide protrusive movement (Figure 14). Their width was predicated on the Golden Proportions, negative space, and the size of the patient’s mouth (Figure 15).

The gingival zenith of the maxillary central incisor and canine sites was evened horizontally; the crest of the lateral incisors was approximately 1 mm shorter. The gingival zenith of the canines and central incisors was positioned toward the distal aspect and on the long axis of the lateral incisors (Figure 16). The gingival zeniths were leveled with flap and osseous regenerative surgery during edentulous ridge augmentation.

With the patient’s head perfectly erect, the maxillary canine/incisor line was paralleled to the horizon. The anterior aesthetic line was achieved with a plane level (Bio-Esthetic Plane Level, Paradent Corporation, Grand Terrace, CA) and mounted on the anatomical face-bow. By reviewing the color photographs and related information and evaluating the provisional restorations, the treatment team was able to reinstate natural form and aesthetics for the patient.

The maxillary and mandibular provisional restorations were temporarily removed, the crown preparations on teeth #6, #8, #9, #11, and #22 through #27 were redefined, and bevels were placed in harmony with the criteria outlined. The patient returned in 2 weeks for a bisque bake try-in. The provisional restorations were removed once again, and the crown restorations were tried in. This process was repeated 2 weeks subsequently, at which time the occlusion was adjusted and the crowns were provisionally cemented.

An open bite centric measurement was taken at an increased vertical dimension of occlusion several weeks following provisional cementation. The models were mounted with a hinge axis face-bow (terminal hinge previously placed on the patient) to retain them in CR once the centric record was removed and the models had been closed together. The provisional restorations were then recemented. The definitive crown restorations were returned from the laboratory within one week, and the maxillary anterior fixed partial denture was provisionally seated. The mandibular crown restorations on teeth #23...
through #26 were cemented permanently with a zinc oxyphosphate cement. Once the occlusion was evaluated, the two mandibular canine restorations were provisionally cemented, thereby allowing further evaluation of the occlusion and aesthetics.

Completion of the Posterior Segment

Teeth #28, #29, and #31 were finalized by the placement of bevels on the shoulders of the preparations, which would improve their marginal seal. A closed centric bite was taken to mount the maxillary to the mandibular models. A PFG crown restoration was seated on tooth #28 with an EBA alumina provisional cement, and a fixed partial denture was used to replace teeth #29 through #31 (Optow Temporary Cement, Waterpik Technologies, Fort Collins, CO).

The maxillary teeth were prepared in a similar manner. The bisque-bakes of the maxillary fixed partial dentures for sites #2 through #5, and #12 through #14 were received for try-in. The crown restorations were then tried in and adjusted as described in the mandibular procedures. The occlusion was adjusted using the bimanual manipulation technique, as defined by Dawson. A cusp-marginal ridge occlusion was established. If a major discrepancy had been present, an open bite centric would have been measured at this time. These posterior crown restorations were returned to the laboratory for the final bake.

An open bite centric was performed several weeks subsequently, utilizing the hinge axis previously marked on the patient. The maxillary anterior fixed partial dentures were seated with a zinc oxyphosphate cement during this visit. Final impressions were taken of the maxillary fixed partial dentures on teeth #2 through #5 and #12 through #14 and sent to the laboratory for the fabrication of the definitive prostheses.

Final cementation of the maxillary and mandibular posterior crowns and fixed partial dentures (Vita Omega, Vident, Brea, CA) except for teeth #22 and #27, was completed within 3 months. Teeth #22 and #27 were completed 12 months subsequently, once it was determined that the rejuvenation was indeed stable (Figures 17 through 19). Bioaesthetic principles and interdisciplinary
approaches have been expanded to consider unity, balance, proportion, symmetry, and harmony to synthesize the total aspect of the patient.

Discussion
When reestablishing vertical dimension of freeway space, phonetics were not considered. According to several investigations, the clinical rest position changes with the vertical dimension of occlusion in an initial adaptation. The interocclusal distance varies since it is controlled by tonic muscle activity, which is influenced by the vertical dimension of occlusion. While airway, posture, tension, and phonetics can influence this position, clinical normal functional movements of the mandible originate from clinical rest rather than phonetics.

The posterior occlusion rises toward the Frankfort plane. The length of the buccal cusps of the canine, first premolar, second premolar, and first molar, measured from the interproximal contact points, were approximately 5 mm, 4 mm, 3 mm, and 2 mm, respectively. The mesial and distal embrasures of the “first” canine generally approximate 90° (Figure 17). Moving posteriorly, the maxillary cusps tips and the gingival marginal crest converge. The embrasure space between the maxillary central incisors is approximately 1 mm, the lateral to central 2 mm, and the lateral to the canine 3 mm. This case supports the theory that the eyes, commissural line, or facial contour should never be used to establish the horizontal plane, since the anatomical plane of occlusion was lower on the left side, and the patient was facially asymmetric. Had one of these elements been used, the horizontal plane would not have been properly established.

Conclusion
This case presentation serves as an example of the achievement possible when an interdisciplinary approach is utilized in dentistry. As demonstrated by this discussion, function and objective aesthetics are interrelated. By determining these principles in the treatment planning phase and incorporating them throughout each aspect of the rejuvenation, the patient’s psychological outlook improved, and her long-term health and well-being will presumably continue for years to come.

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