Bioesthetic Dentistry, Part 1

Kenley Hunt, DDS

Mitchell Turk, DDS

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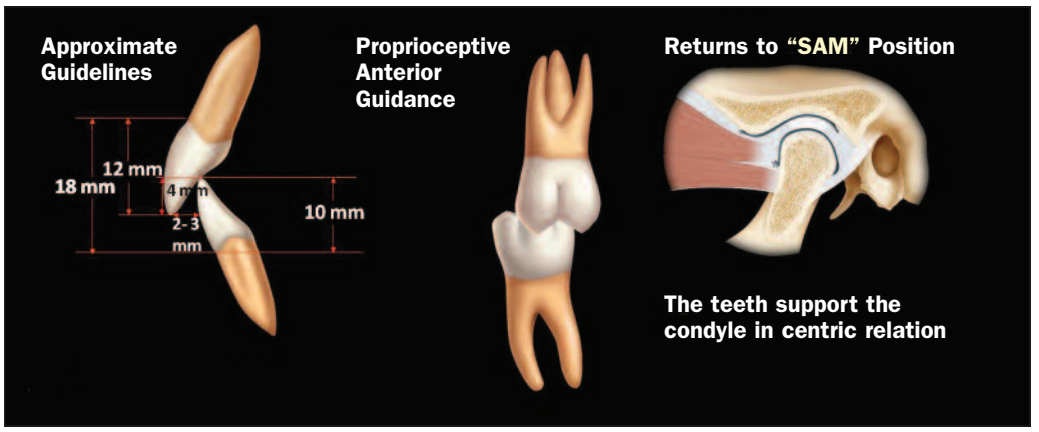
This issue presents part 1 of a series of 4 articles. This article series will discuss the Bioesthetic principles of restorative treatment from preliminary diagnosis through case delivery. This series of 4 articles will serve as a reference for the restorative clinician in evaluating human dentition as a part of an attractive functioning craniofacial structure of the human body, allowing the clinician to arrive at the most conservative restoration and enhancement for any patient. The case used as a basis for this series of articles involves an uncomfortable bite, maxillary anterior wear, and wear on the mandibular canines.

INTRODUCTION

When treating the diseased human dentition, we arrive at a decision: We must either restore the teeth to fit into a worn system and perpetuate the existing state of pathology or treat the entire masticatory/chewing system, reinstating the teeth back into functional harmony with the stomatognathic system as a whole, including the attachment apparatus, the neuromuscular system, and the temporomandibular joint (TMJ). For example, in the name of esthetic dentistry, why do we place veneers on 10 extensively worn maxillary anterior teeth and permit the continued dysfunction to either cause delamination of the veneers or subject the opposing mandibular teeth to severe wear over time? Should we not choose *functional esthetics* instead? If we choose to restore the mastication/chewing system to function optimally, as engineers, we must follow sound principles found in a universally successful model. Therefore, to enhance the young dentition or rejuvenate the older or debilitated dentition, a *healthy human model* is required for reference. This model is based on the maximum health of the human masticatory system, ie, minimal stress on the TMJ and periodontium, minimal wear on the teeth, comfortable muscle activity, good masticating and swallowing function, and good esthetics.



(Illustrations by Dave Mazierski.)

Figure 1. When the condyles are in centric relation (CR), all teeth occlude evenly in the intercuspal position. When occlusal contacts are uneven, posterior occlusal interferences in lateral border jaw movements and avoidance patterns will develop.

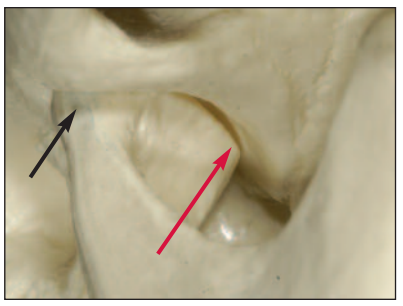


Figure 2. Note that the anatomic shape of the condylar head conforms to the condylar fossae in an upper forward stable condylar position. The black is pointing to the lateral head of the condyle, the red arrow to the medial.

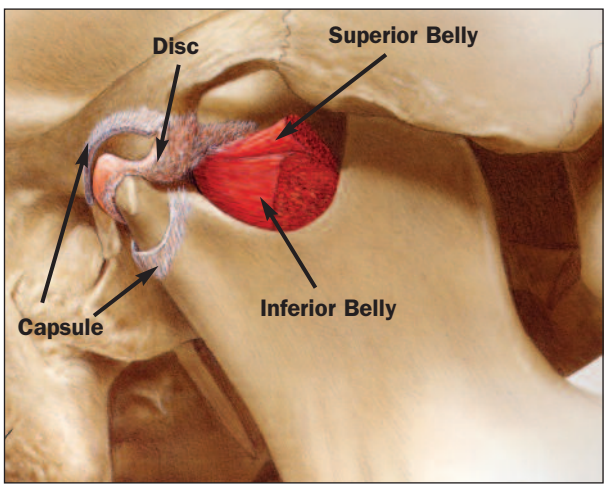


Figure 3. The attachment of the lateral pterygoids, the disc, and the capsular relationship to the condylar head. (*Reprinted with permission from Quintessence Publishing.*[13])

When treating the diseased human dentition, we arrive at a decision....

PRELIMINARY DIAGNOSIS IN THE BIOESTHETIC CASE

This article presents the concept of Bioesthetics and the diagnosis and treatment of a dentition in decline. Each of the future articles that will accompany the current one will utilize a case report to develop an understanding of the Bioesthetic occlusal principles and teach how to clinically develop an optimally healthy result. We will begin with the mounted-model diagnosis, continuing through understanding the biologic role of tooth form, stabilizing and healing the joint and muscles, developing the prototypic end result through a wax-up, and then the final application of dental materials to improve the form of the dentition in the oral environment, thereby creating an esthetic smile and facial rejuvenation.

BIOESTHETICS

Robert Lee, DDS, both a biologist and a dentist, formulated and set forth the biologic, functional, and biomechanical principles noted in his observational research involving individuals more than age 30 years who exhibited unworn tooth form and asymptomatic TMJs.[1,2] Lee coined the title for his study as: "Bioesthetics: The study or theory of the beauty of living things in their natural forms and functions."

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He noted that such near-perfect natural oral environments not only exist and function, but that they also are esthetically attractive. The essence of Bioesthetics (as Lee indicated) is understanding natural healthy tooth and joint form and how the form dictates function. His principles were brief in number, but profound in impact in designing predictable healthy results, from the simple restorative case to complex full-mouth rejuvenation. Success for such comprehensive dentistry is dependent on the clinician's understanding of the morphology of natural dentition, including the relationship of the TMJ and dentition, structure and mechanics of the TMJ, tooth position, gingival contours, and the influence of these elements on the dental, dentofacial and facial complexes.[1] The Bioesthetic approach enables clinicians to go beyond the scope of treating individual teeth so they learn to identify deviations in form that predict continued wear and pathology, such as the wear on the canines in young adults.

He identified 3 Bioesthetic Principles, which required that the following conditions are present and are observed:

Principle 1. The condyles are positioned in a centrically related or centrically adapted position, and the teeth are in, or very close to, maximum interdental occlusion; ie, centric occlusion (CO) = centric relation (CR) (form of the joint).

Principle 2. The incisors and canines have length and form to provide proprioceptive protective guidance and to maintain separation of the posterior teeth during occlusion (form of the anterior guidance).

Principle 3. The natural sharp anatomy of the posterior teeth allows convex interocclusal contacts, creates posterior tooth guidance during occlusion, and enhances chewing efficiency (form of the teeth).[3]

All 3 principles concern the prevention of overload in the masticatory system. Dumont further defined a dentition with these attributes as the ideal "human biologic model (HBM)" (Figure 1).[4]

HUMAN BIOLOGIC MODEL

When examining the ideal HBM, we observe that the ideal human model of teeth depicts unworn form upon eruption. The genetically predetermined form of the teeth is not influenced by any other structure in the masticatory/chewing system. Therefore, following the gnathological notion in designing an anterior guidance 5° steeper than the condylar angle would dictate the presence of flat posterior teeth in any oral environment with shallow condylar angles. Flat teeth would increase occlusal load on all tissues of the chewing system. As a result, the gnathological approach does not allow the utilization of optimal biologic form.

The healthy dentition is naturally sharp, supported by a healthy bone structure and gingival tissues that seal the vascular supply and osseous tissues from the external environment. An *unworn* genetic form of the teeth is maximally efficient in incising and grinding the bolus of food before it is swallowed. Whenever individuals display the natural unworn form of the teeth, they are also considered to be more attractive; at the very least, they are considered to have a "beautiful smile."

To achieve optimal dentistry, the clinical practitioner must become a student, not only of esthetics, but of healthy oral morphology and its important role in optimizing the function of the human chewing system. The length of the incisors and canines play a significant role in proprioceptive anterior guidance. The sharp form of the posterior teeth keep the system downloaded, and the healthy form of the TMJ is instrumental in a stable tooth-to-tooth relationship.[4-11]

Figure 4. Open-bite centric registration. The manibular left side is trimmed. The mandibular right side is untrimmed.

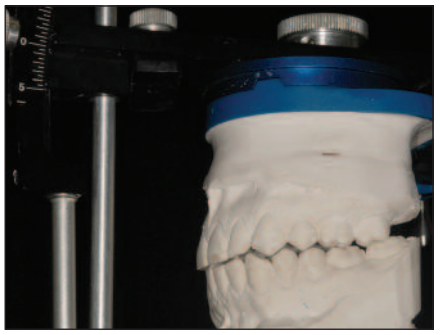

Figure 5. Model mounted for preliminary diagnosis.

Figures 6 to 9. Wear has diminished the quality of the aesthetics and function and places strain on the facial expression.

Figure 10. Arbitrary hinge axis with face-bow.

Figure 11. Dawson bilateral manipulation technique.

CENTRIC RELATION

In the healthy dentition, when the teeth of both dental arches are in complete contact, the condyles are positioned in their most superior/anterior/medial position against the thinnest portion of the articular disc by the means of contraction of elevator muscles, they are in CR. When the CR position of the joint is in harmony with the maximum intercuspation of the teeth, Okeson[12] refers to this as an orthopedically stable position.

The biologic value of centric relation is 3-fold:

1. The anatomic design of the condylar head is seated in the fossa to support chewing forces (Figure 2).

2. The TMJ is in a stable repeatable position, from which the clinician is able to diagnose and design a stable occlusion.

3. Normal compressive forces are important in the health of the joint for transportation of nutrients and metabolic byproducts in and out of the joint disc (wicking and weeping) (Figure 3).[13]

However, there are clinical circumstances where there is no intact disc; where the TMJ has remodeled and may function with the same degree of comfort as an intact, properly-aligned condylar disc assembly in centric relationship (adapted centric).[14,15]

CENTRIC RELATION RECORDS FOR PRELIMINARY DIAGNOSIS

To develop the records for a *preliminary* diagnosis, 3 sets of maxillary and mandibular full-arch impressions are taken with a quality regular-set alginate (eg, Orthogel [Rocky Mountain Orthodontics], Max Print [MDC Dental], Identic Restorative [Cadco]) and poured with a precise water:powder ratio. These impressions must be extremely accurate and be poured immediately. They must capture all of the tissue contours completely to the vestibule. After the stone has set, all imperfections (such as positive bubbles) are removed, especially on the occlusal surfaces and in the gingival areas. One set of maxillary and mandibular models will be unaltered and serve as a documentation of the initial oral condition. The second set will be used to perform a preliminary subtractive coronaplasty (will be discussed in a later article) of the posterior teeth to an optimal vertical dimension and tooth contact. Wax will then

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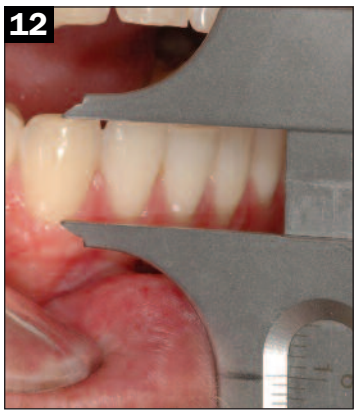

Figures 12 to 16. Although the lengths of the teeth are within a "normal" range of length, they are not healthy in relation to longevity, comfort and function. Note right canine is 2 mm shorter than left canine.

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be added to the anterior teeth to plan the anterior guidance, esthetic form, and incisive display compatible with the smile and the facial appearance. This second set may also be used to create a mockup to overlay the patient's anterior teeth to demonstrate the change of the appearance of the teeth to the patient. The third set of models can be used to fabricate a maxillary anterior guided orthosis (MAGO) stabilizing splint, worn to achieve muscle deprogramming a stable joint position.

To record the true relationship between the joint in a CR position and the contact of the teeth, an open-bite CR record is required to prevent deflection of the teeth during the recording of the bite. The open-bite CR record is made by using a rigid vinyl polysiloxane (VPS) material (Memoreg 2 [Heraeus Kulzer]) on a Panadent bite tray. The thin metal tray is placed in the mouth, and the patient is instructed to bite firmly to distort it and to create minimum space between the metal tray and the posterior teeth. A helpful suggestion is to compress the metal tray against the maxillary second molar with your finger. This procedure minimizes the amount of opening when recording the CR position. The VPS is then applied to the maxillary side of the bite tray, which is then held lightly and motionless against the maxillary teeth. After the VPS is set, a rigid wax compound (Kerr Impression Compound) is placed on the mandibular side of the tray in the anterior region. The compound is softened, and the mandible is then gently guided into the CR position, using the Dawson-recommended bilateral manipulation technique, slightly recording the indentations of the mandibular incisors into the compound with *minimal distance* between the bite tray and the mandibular posterior teeth. If there is too much space between the posterior teeth, translatory movement of the joint will occur. Finally, the VPS bite material is applied to the posterior area on the mandibular side of the tray, and the mandibular anterior teeth are guided back to the indentations in the wax compound, recording the posterior teeth into the VPS material. The VPS material is then trimmed to expose only cusp tips to allow the stone models to fit accurately into the bite record (Figure 4).

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Though the dental articulator (the authors use the semiadjustable Panadent articulator) cannot duplicate the suppleness of human tissue, it is paramount in the ability to transfer information from the human system to an instrument, where the stone models of the dentition can be related in space, then movements of the jaw can be closely duplicated in order to perform an accurate preliminary diagnosis and treatment plan. Only by mounting the case on an articulator with an open-bite CR record, in addition to setting the condylar angle and Bennett shift, can the clinician truly evaluate the discrepancy between the CR occlusion and the CO or what may be termed the habitual bite. For preliminary diagnosis, the condylar angle can be set at 45° and the Bennett shift to 1.5 mm. After the joints are stabilized with the MAGO (Figure 5), they can be measured more accurately.

The anterior guidance can be first evaluated on the articulator to see that in the incisive position, with the maxillary and mandibular incisal edges placed together, there should be at least 2 mm to 3 mm of clearance between the posterior teeth. The canines are then placed tip-to-tip to evaluate the presence of one mm to 2 mm of clearance on the chewing side (working side) and 2 mm to 3 mm on the nonchewing (balancing) side. This clearance prevents interferences of the posterior teeth in closure where the mandible flexes under the load of chewing a hard bolus of food.

A full series of photographs is taken to assess the extent of pathologic wear and evaluate the function of the anterior and posterior guidance. Full-face frontal and lateral views are prepared to evaluate and demonstrate to the patient any facial form abnormalities due to loss of vertical dimension or hypertrophied muscles. Dentofacial views exhibit the incisal display, lip fullness, and the smile-line. Photographic records are also made of the anterior teeth in the incisive position and the right and left canine positions to evaluate the presence of occlusal interference on the posterior and anterior teeth incisive, and right- and left-lateral chewing movements.

One photo is made of the teeth in the habitual bite (CO) position and another in the centric position to evaluate the difference in tooth contact in the 2 positions. Occlusal views will show arch misalignment, poor conditions of restorations, and signs of occlusal overload, such as exostoses, tooth migration, fractured teeth, and excessive wear. Right and left lateral views of the buccal surfaces demonstrate other signs of load, such as abfractions, gingival recession, and gingival clefting. Finally, photographs of the lengths of the teeth, using a Boley gauge, helps to compare the loss of tooth form. These photographs are also useful for the dental laboratory team.

With the models mounted in CR, and prior to any preparatory work, begin by asking diagnostic questions about what is happening to this dentition and why it is happening. Is wear on the anterior teeth present due to the premature contact of the second molars, creating avoidance patterns in closure and resulting in contact of the anterior teeth on inclined planes? Only after the answers to these questions are satisfactorily obtained can the clinician go forward with the treatment questions as to what can be done to restore that particular dentition back to opti-

Figure 17. Initial CR occlusal contacts on the second molars.

Figures 18 and 19. The maxillary right canine and mandibular right premolar are interfering in incisive guidance. Loss of left canine guidance results in nonchewing side interferences on the second molars and chewing side interferences on the first bicuspid.

mal health. Once prepared with the oral soft-tissue exam, the CR mounted models, clinical photographs, and all necessary radiographs and scans, the clinician is now ready to sit down with the patient to discuss the opportunity to return healthy, functional, and esthetic form to the mouth and face.

The point must be emphasized at this stage of diagnosis that the condyles are not truly in a stable position; therefore, this phase of diagnosis is termed "preliminary." Muscle fatigue (bracing), and edema will prevent a stable seating of the condyles in the fossae. Only after the condyles are seated, using a stabilizing appliance (MAGO), can a final diagnosis be made from models of the patient mounted in a stable CR.

CASE REPORT

A case report will be utilized to present the factors discussed above and to develop a diagnosis leading to a treatment plan for this series of 4 articles. Using this case, we will also demonstrate the correlation between the biologic systems that must accommodate the demands of the masticatory forces and the beauty of the appearance of the dentition.

Preliminary Diagnosis and Treatment Planning

A male patient presented dissatisfied with the appearance of his dentition due to the position of the teeth, diastema, and wear (Figures 6 to 9). He also complained that his bite did not feel comfortable. There were no medical, periodontal, TMJ, or decay issues. Digital photographs were taken to note and record the loss of anterior tooth length, due to wear from posterior avoidance patterns. Full-arch maxillary and mandibular impressions were taken with a quality regular set alginate (Orthogel RMO [Rocky Mountain Orthodontics]) and poured with a precise water:powder ratio. An ear-bow was used to record the position of the incisal edges to an arbitrary axis in reference to the Frankfort plane (Figure 10). Care was taken to ensure that the ear-bow was parallel to the horizon prior to securing it in order to properly evaluate the esthetic plane of occlusion. The maxillary model was then mounted on a Panadent articulator, using the ear-bow transfer.

A CR bite registration was performed, using a rigid material (Memoreg 2) and relating the maxillary and mandibular arches in a CR position with the bilateral manipulation technique (Figure 11). This record was then used to mount the mandibular cast against the maxillary cast in a "nonstabilized joint" position (Figure 4). This process was completed in 2 stages. The plaster was added to the mandibular model, and then the articulator was closed while leaving a slight separation between the plaster on the mandibular model and the articulator mounting ring. After the first pour of plaster was set, a small amount of additional plaster was added to fill in the space. This technique eliminates distortion from the expansion of the plaster, allowing better accuracy of the CR-mounted models. The CR-mounted models were sanded to a fine finish, labeled with the patient's name, and placed on a clean articulator ready for the patient consultation.

A discussion was held with the patient regarding the events that resulted in the loss of natural tooth form. The lengths of the right and left maxillary central incisors were approximately 10.5 mm in length, the right and left maxillary canines 10.0 mm and 11.5 mm, respectively, in length, and the mandibular canines were approximately 10.0 mm in length (Figures 12 to 16). There was no midline discrepancy.

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Evaluation of the function of the patient's chewing system from a CR perspective showed a discrepancy between the position of maximum intercuspal position and the CR position. In the CR position, the first point of contact occurred on the second molars (Figure 17). To avoid these undesirable contacts, the patient was using a nonproprioceptive guidance (contact guidance) on the anterior teeth, resulting in wear on the incisors. As a result, in incisive guidance, the maxillary right canine is contacting instead of the maxillary and mandibular central incisors (Figure 18). In lateral canine guidance, it could be seen that the nonchewing interferences were occurring on the second molars on the left side. To avoid these contacts, the neuromuscular system directed the mandible to the contralateral canine, the avoidance pattern, and the resulting contact guidance lead to wear on the right canine. This wear allowed simultaneous contacts on the right chewing side, creating wear facets on the posterior teeth and resultant loss of tooth form (Figure 19). The wear on the anterior teeth, including the mandibular canines, created the unesthetic appearance of the smile. The disharmony between the centric relation of the condyle (CR) in the fossa and the maximum intercuspation of the teeth resulted in the lack of a stable feeling in the bite. Failure to treat the condition would result in a continued degeneration of the chewing system structures and the appearance of the face.

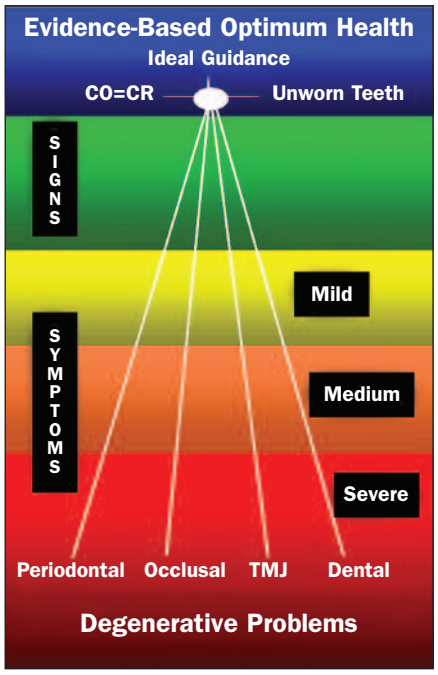

Figure 20. With the use of the optimum health convergence diagram, we can gain perspective regarding our current dental care.[3]

Using the articulator, photographs, digital x-rays, and the comprehensive examination, a sound preliminary diagnosis of occlusal disease was made. The treatment was centered on the replacement of natural form. The tentative treatment plan involving joint stabilization, coronaplasty, and restoring the anterior teeth to proper genetic form (feldspathic porcelain veneers) was presented to the patient. This plan describes to the patient and the clinician where they are going and why. However, if the condyle changes significantly following the splint therapy, the plan may have to be changed as well.

CLOSING COMMENTS

What had previously been missing in dentistry is a positive "go to" concept of the ultimate healthy dental system. This concept is characterized at the top of the diagram by "Optimum Health" (Figure 20).[3] While treatments may differ, the goal would always be the same! The ideal HBM provides a solution for treating our dental system biologically and sets the standard for all levels of care, including periodontics, orthodontics, and orthognathic surgery. The noble goal of providing for our patients, either young or old, attractive and functional dentitions can be achieved by following the principles and procedures as will be outlined in this series of 4 articles. Practicing dentistry with these sound principles ensures that the clinician will be able to help the patient achieve the highest level of health and a return to natural genetic tooth form.

The second article in this series will present the relationship of natural form and masticatory function and their consideration in the treatment plan.✦

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Dr. Hunt is a graduate of Fairleigh Dickerson University Dental School, and maintains a private practice in Brea, Calif. Dr. Hunt can be reached at kenhunt@surfside.net.

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Dr. Turk is a graduate of the University of Southern California Dental School, and maintains a private practice in Orange, Calif. Dr. Turk can be reached via e-mail at gmturk@mouthdoc.com.

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