AESTHETIC DESIGN PRESERVATION IN MULTIDISCIPLINARY THERAPY: PHILOSOPHY AND CLINICAL EXECUTION

Ernesto A. Lee, DMD*
Sang K. Jun, CDT†

Complex perio-prosthetic cases that require multidisciplinary therapy often result in compromised aesthetics. Traditional treatment planning philosophies, as well as existing interdisciplinary relational patterns, do not promote the achievement of predictable aesthetic results. Implementation of a restorative-driven approach requires the development of an aesthetic blueprint that will serve as a guide through treatment. This article illustrates the clinical techniques and sequence for an outcome-based protocol that enhances therapeutic cohesiveness and ensures the sequential transfer of design objectives for the preservation of aesthetics in multidisciplinary therapy.

Key Words: multidisciplinary, prosthesis, template, aesthetic

*Adjunct Professor, Postdoctoral Periodontal Prosthesis, University of Pennsylvania School of Dental Medicine, Philadelphia, Pennsylvania; Adjunct Professor, Advanced Esthetic Dentistry Program, New York University College of Dentistry, New York, New York; private practice, Bryn Mawr, Pennsylvania.
†Laboratory technician, Bay Dental Laboratories, Monterey, California.

Ernesto A. Lee, DMD, 976 Railroad Avenue, Ste 200, Bryn Mawr, PA 19010
Tel: (610) 525-1200 • Fax: (610) 525-1956 • E-mail: ealeedmd@msn.com
Predictable aesthetic outcomes resulting from multidisciplinary treatment approaches have traditionally represented elusive goals. This may be partially due to the level of complexity that is associated with these clinical scenarios. In addition, it may be a result of the inadequate interaction between the specialists involved (Figure 1).1 The role of the patient’s perception in determining acceptable treatment outcomes also constitutes a potential obstacle in achieving aesthetic success.2-4

Patients who require multidisciplinary therapy may fall into two different categories. There are situations where conformance with the standard of care demands the inclusion of several dental specialties within the therapeutic team (Figures 2 through 4). Alternatively, there are scenarios where the patient may be treated in a satisfactory manner with a compromised restorative solution, and adjunctive procedures are, nevertheless, incorporated to enhance the definitive aesthetic result.

This article will describe an aesthetic-driven sequence and treatment rationale that may promote increased cohesiveness of the clinical team involved in rendering multidisciplinary therapy. The treatment philosophy and techniques required to ensure the accurate transfer of the initial restorative design through all adjunctive procedures and various phases of clinical execution are illustrated and discussed herein.

Aesthetic-Driven Multidisciplinary Therapy
Aesthetic success can be reliably predicted only through the development of a systematic treatment approach that includes the comprehensive integration of a previously defined restorative outcome. This concept is not unlike the generally accepted restoration-driven approach to implant therapy, which includes the development of a prosthetic blueprint early in therapy.5,6 Aesthetic-driven multidisciplinary therapy requires a philosophical departure from generally accepted concepts regarding the treatment planning and sequence of adjunctive procedures. Furthermore, a reevaluation of the currently utilized definitions and the relationship between form and function as it relates to the masticatory system is appropriate vis-à-vis the prevailing clinical ethos to subordinate form to functional requirements.
The role of the human dentition has evolved in conjunction with the progress of mankind. In primitive societies, the stomatognathic system primarily fulfilled alimentary needs, and its functional integrity would often be associated with the individual's survival. Any contemporary definition of the functional role of the human dentition in modern society, however, cannot be limited solely to masticatory activity. A healthy self-perception of aesthetic adequacy carries emotional, psychological, and social benefits. Since the appearance of the teeth constitutes a major component of the facial composition, the aesthetic aspects of the dentition must be identified within a functional context. It is appropriate in this regard that clinicians view their treatment goals as extending beyond the compartmentalization of the oral cavity, focusing instead on the benefit of the patient as a whole.

**Does Form Follow Function?**

The postulate stating that “form follows function” was initially utilized in a biologic context by Jean-Baptiste de Lamarck, an 18th century French zoologist, as part of his theory of natural adaptation. Lamarck deduced that anatomical forms developed as a response to environmental demands and that these organic adaptations eventually became part of the genetic pool and were transmitted to offspring of the species. A typical example was the giraffe, which was thought to have developed its elongated neck and body shape as an adaptation to more effectively access its food supply. Even though this theory eventually fell out of favor largely as a result of the acceptance of Darwin’s theory of evolution by the scientific community, the form follows function postulate continued to be utilized in many of the biological sciences.

Unfortunately, it is this teliologic belief that provides the framework for the philosophical acceptance of aesthetic compromise, when in fact there is no scientific or technical basis to support its raison d'être or applicability — at least within the context of restorative dentistry. In other words, if form does indeed follow function in restorative dentistry, then aesthetics are secondary to biological and biomechanical considerations. Conversely, if aesthetic acceptance is one of the requirements that must be fulfilled in order to achieve success in restorative dentistry,
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biological and biomechanical limitations must be figured into the equation during the development of the aesthetic proposal. Indeed, it may be more appropriate to state that new algorithms must be developed to better articulate the relationship between form and function.

Clinically Relevant Aesthetic Blueprints

The successful integration of aesthetics and functionality does not emerge by chance, but as a result of the meticulous development of clearly defined anatomical parameters and their subsequent incorporation into the design of the prosthesis.\textsuperscript{10,12} This process requires an initial visualization of the desired end result, followed by a protocol that allows the progression from the realm of the abstract to concrete and material clinical objectives.

The establishment of the aesthetic scheme must be considered an integral component of the diagnostic phase. Once aesthetic objectives are defined, adjunctive treatment considerations are developed to support the desired restorative outcome. This approach advances a departure from traditional treatment planning sequences in that it organizes all adjunctive therapy in subordination to the desired aesthetic result, except for control of active disease processes and emergency procedures.\textsuperscript{12}

Complex treatment planning approaches are often necessary in situations where multidisciplinary therapy is indicated. The recruitment of specialists per se does not, however, have an additive effect on the desired aesthetic outcome. The preservation of aesthetics through multidisciplinary therapy requires the development of the clinical team into a cohesive therapeutic network supported by the establishment of a clinically relevant aesthetic template.

Development of the aesthetic proposal and subsequent blueprint will help to identify specific therapeutic objectives for each specialist involved in the multidisciplinary team and the laboratory technician as well. Individual specialty procedures cannot be subject to the whim of each clinician’s perspective, but rather require subordination to the aesthetic scheme. This demands that specific guidance be provided for the specialist in terms of clinical objectives. The aesthetic blueprint additionally needs to fulfill requirements of clinical relevancy in that it must easily convey the parameters within which each specialty procedure must be performed, all this presented in a practical and accessible format. Surgical guides and therapeutic templates are thus developed, providing a mechanism for the specialists to intraoperatively verify compliance with previously established performance parameters.

Figure 9. Tooth reduction was initiated from the ultimate incisal edge position. Preparation design followed the anticipated contours of the definitive restorations.

Figure 10. Completed preparations exhibited adequate parallelism to allow fabrication of the planned metal-ceramic splints for control of secondary occlusal trauma.

Figure 11. Gingival margin levels were verified and revised using the diagnostic template for sequential transfer of the initial aesthetic design.

This process is often initiated with the development of a diagnostic waxup. The diagnostic waxup must be developed to reflect any contributory adjunctive procedures that may be contemplated as part of the multidisciplinary treatment plan, with the purpose of establishing an aesthetic restorative design in the wax stage that will...
The utilization of techniques that allow the intraoral testing of the restorative proposal constitutes the most valuable resource in the assignment of clinical relevancy to the aesthetic blueprint. Whether it is through the use of direct trial composite veneers, removable aesthetic templates, or provisional restorations; aesthetic treatment objectives can be clinically refined and accurately represented to the patient only by trial in an in vivo environment.12

Orthodontic Considerations
Orthodontic treatment is often an integral component of multidisciplinary therapy, frequently enhancing the aesthetics of the final restoration. A distinction must be made, however, between such instances where orthodontic movement is primarily utilized to facilitate the completion of a prosthesis without aesthetic compromise and clinical scenarios where complex functional and pathologic involvement require the use of orthodontic therapy in order to comply with the standard of care.

The beneficial effects of orthodontics in multidisciplinary therapy can only be optimized provided that the tooth movement is designed to support a preestablished aesthetic scheme. This methodology is advantageous in that it identifies an endpoint reference position to which the teeth must be moved. The orthodontic blueprint must be aesthetically generated, with anterior tooth display considerations constituting a significant determinant of ultimate tooth position. Exclusive reliance on cephalometric analysis or occlusal relationships based on Angle’s classification may not be an adequate approach in instances that exhibit a lack of coincidence with optimal dentolabial aesthetics.1,13

Although orthodontic therapy is primarily utilized to improve tooth position and interarch relationships, its effects on osseous architecture and soft tissue remodeling may be advantageously applied in the treatment of periodontally compromised dentitions (Figures 5 through 8). To this effect, Ingber reported on the use of orthodontic forced eruption for the treatment of periodontal vertical defects.14 The attendant bone remodeling results in a favorable modification of the osseous defect while improving the alveolar bone architecture as well. In addition, the coronal migration of the attachment apparatus will be accompanied by gingival tissue changes that result in the eversion of sulcular epithelium and a concomitant decrease in probing depths. This application is a common feature in the management of periodontal/prosthetic cases, where it may be utilized in conjunction with the aesthetic blueprint concept to create powerful therapeutic synergies.

Orthodontically induced bone remodeling may also be utilized for the development of future implant sites.15 When appropriately integrated into the overall treatment scheme, this technique can provide one of the most predictable sources for vertical bone augmentation, offering...
additional advantages with regard to time efficiency, while remaining a nonsurgical approach as well.

Tarnow et al studied the relationship between the proximal contact and the underlying osseous crest and its effect on the presence or absence of a gingival papilla. Their findings demonstrate that papillae were present 100% of the time whenever the distance between the proximal contact and the osseous crest did not exceed 5 mm. There are currently no surgical approaches to predictably regenerate missing gingival papillae. With a combination of interproximal ameloplasty and subsequent orthodontic space consolidation, however, the proximal contact to osseous crest relationship can be favorably modified to promote formation of a gingival papilla (Figures 5 and 6). Thus, orthodontic therapy provides the only available means of predictably regenerating deficient gingival papillae, and as such it constitutes an invaluable technique in the aesthetic armamentarium.

**Periodontal Considerations**

Complex cases that require multidisciplinary therapy often incorporate significant periodontal etiologic factors. Advanced loss of attachment, secondary occlusal trauma, and the presence of parafunctional habits are commonly present in periodontal/prosthetic cases, along with migration of teeth, posterior bite collapse, and loss of occlusal vertical dimension. Preserving aesthetics through the delivery of periodontal therapy under these circumstances differs significantly from those scenarios where periodontal procedures are performed primarily for aesthetic purposes, and its proper execution requires an altogether different mindset and skill level as well.

Periodontal etiologic factors must be carefully ascertained, particularly in patients who exhibit a pattern of attachment loss and clinical characteristics that deviate from those usually associated with adult periodontitis (Figures 3 and 4). Clinical profiles suggestive of conditions such as rapidly progressive periodontitis are of concern due to their resistance to conventional periodontal therapy as well as their refractory nature. These patients require a keen evaluation that must include bacterial sampling and culture, followed by adjunctive antibiotic management.

Planned periodontal procedures should be performed preoperatively on study models. Diagnostic templates or waxups will be subsequently developed reflecting the anticipated postsurgical gingival margin levels (Figure 6). In any situation where a revision of the gingival margins is being considered, bone sounding is compulsory to identify the level of the alveolar crest and ascertain the need for osseous surgery. Following bone sounding, several scenarios are possible. Ideally, there may be sufficient tissue present coronal to the osseous crest to allow for a gingivectomy or gingivoformplasty procedure that will establish the desired gingival margin position without violating the biologic width. Another possibility is the presence of sufficient gingival tissue to allow the reposition of the gingival margin without exposing the osseous crest but nevertheless impinging on the biologic width. The latter situation allows the restorative dentist to establish the optimal gingival margin levels with the provisional restoration, which is subsequently utilized by the periodontist as a surgical guide for contouring the osseous crest to reestablish the biologic width space without altering the previously determined gingival margin levels.

Bone sounding may alternatively reveal a situation where repositioning the gingival margin to the desired postsurgical level will not be feasible without exposing the osseous crest. This scenario precludes any gingival revision prior to surgical bone recontouring. In these cases,
a surgical guide derived from the aesthetic blueprint must be provided to the periodontist to serve as a template during surgery. Following flap reflection, the surgical guide will aid the clinician in establishing a constant relationship between the anticipated clinical crown margin and the osseous crest levels (Figure 7). The periodontist is also instructed to reposition the flaps rather than apically position them, therefore preserving sufficient amounts of supracrestal tissue to allow for the anticipated revisions to the gingival margin levels once healing from the osseous surgery has been completed (Figures 9 through 11).

**Restorative Considerations**

Measures must be taken to ensure that the definitive restoration replicates the anatomic details developed in the finalized provisional restoration. This process is initiated intraorally with the use of silicone indexes of the provisional prosthesis to verify adequate tooth reduction (Figure 13). To this effect, it is important to note that tooth preparation must follow outcome-based guidelines, where the appropriate amount of reduction is determined based on the outline form desired in the definitive prosthesis. In other words, although 1.5 mm to 2 mm of tooth reduction will provide sufficient space for metal-ceramics, this space should not be measured from the unprepared tooth surfaces but from the projected contour of the final restoration (Figures 9 and 10).

Once space requirements are satisfied, the procurement of accurate definitive impressions is quintessential to the fabrication of indirect restorations. Adequate periodontal health is a prerequisite to maintain predictable postimpression gingival margins. The presence of ulcerated sulcular epithelium as well as an inflammatory infiltrate in the connective tissue attachment promotes extravasation and increases sulcular fluid flow, both of which may impede the achievement of adequate hemostasis and moisture control. Additionally, the response of inflamed tissues to the impression procedure is variable and will decrease the predictability of the ultimate gingival margin levels.

The double-cord elastomeric impression technique has proven extremely reliable. Atraumatic cord placement is mandatory if soft tissue marginal integrity is to be maintained. Proper technique will limit cord placement to the gingival sulcus and the junctional epithelium. In the presence of adequate gingival health, displacement of the provisional prosthesis, the latter may be utilized as a guide during adjunctive treatment procedures. Multidisciplinary cases requiring significant orthodontic therapy may present an exception, though, since it may not be practical to predict extensive changes in tooth position with sufficient accuracy to warrant developing the provisional prosthesis directly from the diagnostic waxup.

Following intraoral placement, the provisional prosthesis is gradually modified until all the objectives required in the final restoration have been achieved. Once this is accomplished, the functional and aesthetic outcome has been defined in the finalized provisional prosthesis, creating a template from which the design of the definitive restoration will be generated (Figure 12).
of the hemidesmosomal epithelial attachment will not elicit bleeding, and extravasation will occur only if trauma is introduced at the connective tissue attachment level (Figures 14 through 16).31

Finally, a category of restoration congruent with the previously established functional and aesthetic objectives must be selected. Complex periodontal prosthetic cases with advanced periodontal involvement including secondary occlusal trauma require splinting, and this is most predictably accomplished with the use of porcelain-fused-to-metal prostheses (Figures 17 through 19).17

**Laboratory Considerations**

Precise intraoral replication and occlusal articulation are critical requirements to initiate the laboratory phase. Nevertheless, interocclusal relationships inclusive of traditional face-bow transfer techniques do not constitute sufficient information per se for the reliable visualization of dentofacial aesthetic parameters in an indirect environment, such as a remotely located laboratory precluding patient/technician contact.32 It is imperative that an aesthetically oriented face-bow technique be utilized, allowing for the transfer of the relationship between the occlusal plane and the horizontal plane of reference. Contrary to popular belief, the bipupillary line is of little value to the technician unless it is parallel to the horizontal plane. Additionally, photographic documentation displaying the patient’s facial features is essential to develop a harmonious dentofacial composition.33

Aesthetically demanding circumstances may be managed through the use of a full-shade waxup technique.34 The waxup is developed on a refractory model to full contour and color characteristics. These will not only include a general shade but also color mapping schemes, as well as individual variables taking into consideration the patient’s age and physiognomic characteristics (Figure 17).

The wax copings possess sufficient strength and retention to allow complete seating over the prepared teeth, therefore facilitating intraoral testing. Highly specific aesthetic details (e.g., enamel craze lines, incisal halos, decalcification areas, and surface textural patterns) may be incorporated in the wax. This technique allows the patient and clinician to prospectively evaluate the in vivo appearance of the proposed restorations and effect any appropriate modifications. More importantly, the ceramist can subsequently fabricate definitive restorations that accurately replicate the full-shade waxup, including minute characterization details (Figures 20 and 21).35,36

**Conclusion**

The preservation of aesthetic objectives in the treatment of functionally compromised dentitions that require multidisciplinary therapy represents a considerable clinical challenge. Not only are there more demands of associated skill levels, but a different mindset is required to allow a conceptual departure from traditional therapeutic paradigms. It is important to differentiate between
these types of scenarios and those where adjunctive procedures are performed primarily in pursuit of aesthetic objectives. While not unchallenging, the delivery of aesthetic results in the absence of pathology or dysfunction constitutes an altogether different endeavor.

Generally accepted treatment planning concepts organize the sequence of therapy into phase I, aimed at initially addressing existing and active disease processes, followed by phase II, which includes corrective and restorative procedures. This traditional compartmentalization of treatment and thought process is not conducive to the achievement of aesthetic outcomes in multidisciplinary scenarios. Instead, the introduction of the aesthetic blueprint and its development during the diagnostic phase, as well as strict adherence to an aesthetically oriented outcome-based methodology, will result in enhanced integration of the specialties. This approach requires that all adjunctive procedures be designed to support the previously defined aesthetic endpoint. Thusly conceived, specific clinical objectives are identified for every member of the clinical team. As a matter of clinical practicality, therapeutic aids must be provided to allow every specialist to intraoperatively verify compliance with the blueprint. The clinical challenge consists in ensuring that aesthetic design continuity will be preserved through the various therapeutic phases leading to completion of a final restoration that satisfies all functional requirements.

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References
1. In contemporary restorative dentistry, rather than “form follows function,” it may be more appropriate to state that:
   a. This equation is not applicable in restorative dentistry.
   b. Form must be subordinated to function in all medical sciences.
   c. New algorithms must be developed to define the relationship between form and function.
   d. Form is such an important consideration that it should supersede all functional requirements.

2. In order to optimize aesthetic results, orthodontic therapy should be ultimately driven by:
   a. The patient’s aesthetic desires.
   b. The Frankfurt horizontal plane.
   c. Anterior tooth display considerations.
   d. None of the above.

3. An outcome-based aesthetic treatment plan is characterized by:
   a. Development of an aesthetic blueprint in the diagnostic phase.
   b. A departure from traditional phase I/phase II treatment sequences.
   c. Adjunctive treatment designed to support the desired aesthetic outcome.
   d. All of the above.

4. According to this article, a critical factor for the preservation of aesthetics through the multidisciplinary treatment process is:
   a. Enhanced communication with the dental laboratory.
   b. Ensuring the team arrives at a diagnostic consensus.
   c. The recruitment of specialists from several disciplines.
   d. A cohesive clinical team working with a clinically relevant aesthetic blueprint.

5. Orthodontic therapy is utilized in the treatment of periodontally compromised teeth to:
   a. Optimize tooth alignment prior to splinting.
   b. Correct the emergence profile of the abutment teeth.
   c. Improve interarch relationships as well as soft tissue profile.
   d. Favorably modify osseous defect morphology through forced eruption.

6. Currently, the most predictable way of regenerating deficient gingival papillae is:
   a. The double pedicle flap technique.
   b. Orthodontic therapy in conjunction with interproximal ameloplasty.
   c. Use of an allograft membrane over a particulate bone grafting material.
   d. None of the above.

7. The evaluation of clinical scenarios suggestive of rapidly progressive periodontitis require:
   a. A special periodontal probing technique.
   b. Electron microscopy and immunofluorescence analysis.
   c. Sequential digital radiography and sulcular fluid flow measurements.
   d. Bacterial sampling and culture, followed by adjunctive antibiotic therapy.

8. In any situation where the relocation of gingival margins is being considered, it is essential to:
   a. Have provisional restorations with precise margins.
   b. Preview the expected results with diagnostic imaging.
   c. Ensure that the appropriate type of laser is selected.
   d. Perform bone sounding to identify the location of the osseous crest.

9. The transfer of anatomic details developed in the provisional restoration to the definitive prosthesis is ensured through the use of:
   a. Accurate photography.
   b. A thorough record of all modifications implemented.
   c. Precise measurements utilizing calibrated instruments.
   d. None of the above.

10. It is imperative to utilize an aesthetically oriented facebow transfer technique because:
    a. Full pantographic registration is technique sensitive.
    b. The bipupillary line must be registered with precision.
    c. Interchangeability between semi-adjustable articulators will be ensured.
    d. The relationship between the occlusal and horizontal planes must be accurately captured.