The Interrelationship of the Orofacial Complex and Its Effect on Smile Design

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For those of us who continue to strive to improve our abilities and understanding in the delivery of highly esthetic smiles, we must constantly remind ourselves to look beyond the teeth. The old adage of "you can't see the forest for the trees" perhaps signifies all too often the limited vision many of us have been guilty of in our design of a patient's smile. Thanks to the contributions of many talented individuals in the area of cosmetic dentistry, we can now more predictably separate out each of the factors that comprise beautiful smile design and then put them together to produce a highly esthetic and harmonious result.

Evaluating the Facial Complex

If we evaluate the entire facial complex of the patient, we can begin to see the interrelationships that exist between all of the facial features and how they may affect the patient's appearance. Teeth interact and must harmonize with three frames of reference: face, lips, and gingiva.[1] A higher level of esthetic value is attained when there is a level of parallelism and symmetry among features within the face and smile. This parallelism is exemplified through horizontal reference lines on the face. The reference lines, primarily of concern for the purpose of tooth orientation in smile design, include the interpupillary line and the lip lines. Supplemental to these lines of reference are the ophriac (eyebrows) and commissural lines (Figure 1).[1]

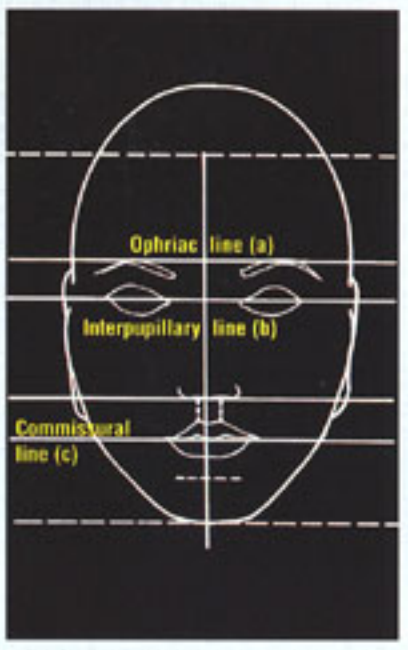

Figure 1—Horizontal reference lines: (A) ophriac line, (B) interpupillary line, and (C) commissural line.

Establishing the proper frame and reference in smile design involves additional consideration of the vertical reference lines, which include the facial midline, sagittal references, and phonetic references. This article focuses on the evaluation of the horizontal references, the soft-tissue relationship to these references, and the effect they have on dental and facial esthetics.

Figure 2—Desired parallelism between interpupillary line, lip line, and incisal edge position.

Interpupillary Line

The interpupillary line is the horizontal line drawn from the pupils of each eye and is compared to the horizontal direction of the incisal plane and the gingival margin outline.[2] The ideal dental perspective would exhibit a close degree of parallelism between all of the above (Figure 2). However, many patients exhibit some degree of discrepancy and reveal canting of the maxilla, resulting in an unesthetic angulation of the hard tissues (teeth) and soft tissues (gingival margins) (Figures 3 and 4). This phenomenon can be very subtle, needing only slight alteration of the gingival margin to improve the relationship to the facial horizontal planes, or it may be extremely profound, necessitating the use of several treatment modalities, such as periodontal plastic surgery, orthognathic surgery, orthodontics, restoration of the teeth with crowning or veneering, or a combination of treatments.

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Upper Lip Line

The upper lip line is the horizontal reference line that allows analysis of the length of the central incisors at rest and during smile and the vertical position of the gingival margins during smile (Figure 5).[1] In

***Figures 3 and 4**—Views showing smile canting.*

Figure 4

***Figure 5**—Upper lip reference line allowing analysis of central incisor length.*

addition, close observation will often reveal parallelism between the inferior border of the upper lip at the midline and the interpupillary line during natural smile.

Lower Lip Line

The lower lip line provides a plane of reference for evaluating the curvature of the incisal plane.[1] The relationship of the incisal edges of the anterior teeth to this curvature can vividly and dramatically affect the appearance of a patient's face and smile. The effect can be significant on how youthful or how aged a smile appears (Figures 6 through 9).

Figures 6 through 8 show a reverse smile line when compared to the curvature of the lower lip. In other words, the incisal edges of the centrals and laterals and the cusp tips of the cuspids exhibit a concave appearance when compared to the position of the lower lip. By lengthening the central and lateral incisors and the cuspids and bicuspids in an incisal/occlusal direction, the relationship of the incisal edges of the teeth more closely follows the curvature of the lower lip. This manifests as a convex rather than a concave relationship to the lower lip, which lends itself to a more youthful smile (Figure 9).

Case 1

A 25-year-old college student presented to our office for cosmetic dental evaluation. She had previously undergone an orthodontic evaluation. It had been explained to her that her teeth could be aligned orthodontically; however, tooth size, proportion, and gingival architecture would be minimally affected. Therefore, she opted for cosmetic dentistry, which could provide the desired results.

Through diagnostic models; comprehensive dental, periodontal, and radiographic examination; preoperative photographs; and interviews with the patient regarding his or her expectations, we were able to formulate and design a treatment plan that would accommodate the esthetic needs of this patient.

The patient's arch form was in need of improvement because of the labially displaced lateral incisor. Limited orthodontic treatment was initiated to reposition the lateral incisor. After repositioning was attained and excellent oral hygiene maintained, crown lengthening became the consideration. Through the use of diagnostic models, diagnostic wax-up, and periodontal evaluation along with preoperative clinical evaluation of lip position in full and natural smiles, it was determined that crown lengthening would be necessary to attain the desired esthetic result.

***Figures 6 through 9**—Lower lip reference line showing concave incisal edge shape.*

Figure 7

Figure 8

Figure 9

Lip Line Plotting

Clinical evaluation of the patient's lip position during full and natural smile positions can be attained and transferred to diagnostic casts through a technique I call *lip line plotting*. This involves marking the gingiva with an alcohol pen above each tooth at the inferior border of the upper lip at full and natural smile positions, which will result in a pattern of ink dots that depict the lip positions. Next, distance readings from the existing apex of the gingival margin over each tooth to each of the ink dots on the gingiva are taken and transferred to the diagnostic models. The dots are then connected, giving you a reference on the models as to the location of the lip.

Predicting the Gingival Margins

With data gained from the periodontal examination, you can now establish a reasonable means of predicting where you would like the proposed gingival margin to be placed and how it would relate to the lip line. After this is established, the diagnostic wax-up can be completed, giving a preoperative visual of the ideal tooth-to-gingiva-to-lip relationship. In this case, the measurement exceeded the limits of

conservative treatment through simple gingivectomy, indicating flap elevation and osseous resection.

To have the gingival margins properly located, the bone needed to be resected to a position at least 3 mm apical to the level of the proposed tooth preparation.[3] After levels of the proposed gingival position were marked, they were evaluated to ensure that the desired interpupillary line and lip line reference planes were in reasonable parallel position to the proposed esthetic gingival pattern.

Surgical procedures were implemented and completed, followed by an 8-week waiting period to allow for complete maturation and healing of the area. Anterior crown lengthening now allowed for closer adherence to the ideal smile design guidelines. This most obviously allowed more latitude for attaining ideal length-to-width ratios and Golden proportions. In addition, the attainment of a more highly esthetic gingival architecture allowed for a pleasing tooth arrangement in harmony with the lips, eyes, and face of the patient.

A higher level of esthetic value is attained when there is a level of parallelism and symmetry among features within the face and smile.

Final Result

Figures 10A through 10F show the preoperative and postoperative views with horizontal lines superimposed to reflect reference plane comparisons. When compared to the interpupillary line, the horizontal reference lines of the gingival margins and the incisal edges are clearly in visual conflict. Close examination of Figure 10G shows the in-progress lengthening procedure on one side and the untreated opposite side. Gingival margins on the untreated side show considerable irregular direction, and the incisal edge position is uneven and not parallel to the interpupillary reference line. Further critiques of this smile would include microdontia of the lateral incisors, spacing, poor tooth mass proportions, and unattractive gingival display. In other words, visual discord within the orofacial complex.

Correction of these anomalies within the patient's smile primarily focuses on the proportion needed for teeth (hard tissue) and the gingiva (soft tissue) to relate appropriately to the remaining facial structures (eg, eyes and lips) (Figures 10H through 10K). As previously stated, preoperative planning through diagnostic wax-up and lip line plotting laid the foundation to a predictable result. The postoperative view in Figure 10L reveals the esthetic benefit gained through prudent smile

***Figure 10A**—Full face preoperative view.*

***Figure 10B**—Full face preoperative view with reference lines drawn showing adverse incisal edge position and gingival margin position relative to the interpupillary horizontal plane.*

***Figure 10C**—Preoperative left lateral view.*

***Figure 10D**—Preoperative left lateral view with superimposed reference lines.*

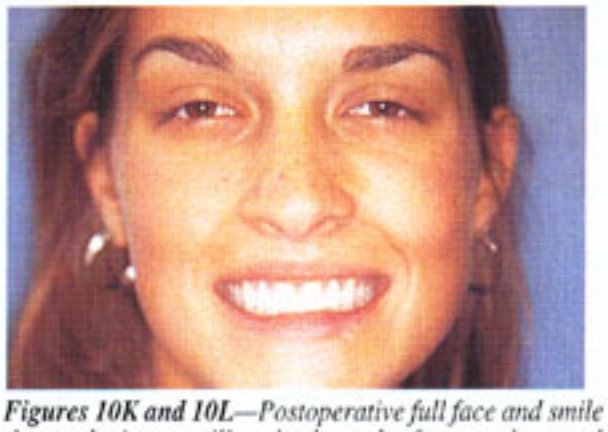
***Figure 10E**—Preoperative right lateral view.*

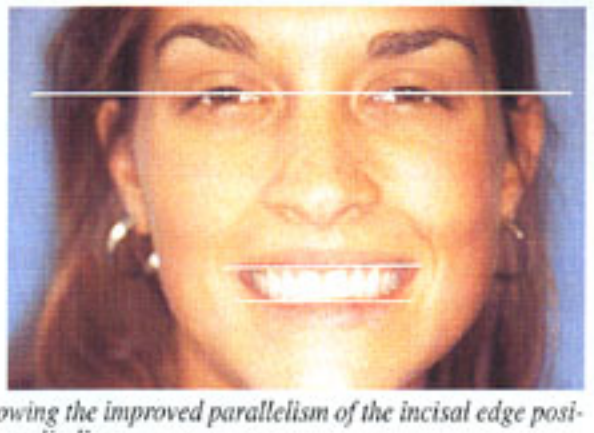
***Figure 10F**—Preoperative right lateral view with superimposed reference lines.*

***Figures 10G and 10H**—In-progress lengthening procedure.*

***Figures 10I and 10J**—Postoperative frontal view of completed procedures showing improved alignment and parallelism of the incisal edge position relative to the gingival margin position.*

***Figure 10J**—Postoperative frontal view.*





***Figures 10K and 10L**—Postoperative full face and smile showing the improved parallelism of the incisal edge position to the interpupillary horizontal reference plane and upper lip line.*

design, which included the use of facial reference line in tooth and gingival margin location.

Case 2

Although this case exhibits a different set of esthetic circumstances, the preoperative preparation is consistent with Case 1, as it is with all esthetic cases. Evaluation of this patient's smile revealed prominent central incisors, extensive variation of the incisal edge position, tooth proportion inadequacies, and nonparallelism between the gingival margin plane and the incisal edge plane (Figures 11A through 11F).

Preoperative Examination

A preoperative clinical examination revealed that, in natural smile, the patient did

***Figures 11A and 11B**—Preoperative full face views showing asymmetries of teeth and gingiva, and the nonparallelism of the reference lines.*

***Figures 11C and 11D**—Preoperative 1:1 view showing asymmetries of teeth and gingiva, and the irregular nonparallel position of the incisal edge position relative to the gingival margin position.*

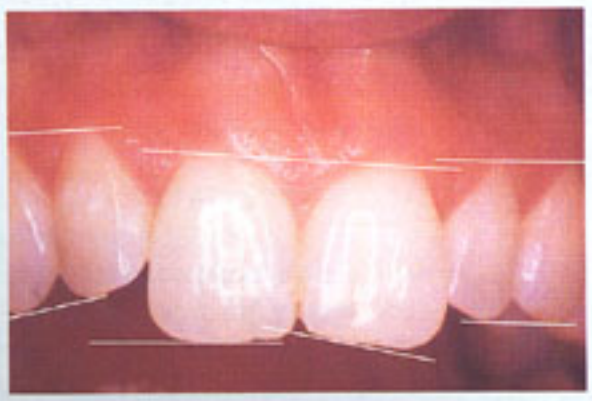


***Figure 11D**—Preoperative 1:1 view.*

***Figures 11E and 11F**—Preoperative natural smile exemplifying disharmony between incisal edge position and upper lip line.*

***Figures 11G and 11H**—Postoperative natural smile showing corrected proportions of teeth and improved incisal edge position relative to the upper lip line.*

***Figures 11I and 11J**—Postoperative 1:1 view showing corrected proportions of teeth, confluent gingival architecture, and improved parallelism between the incisal edge position and the gingival margin position.*

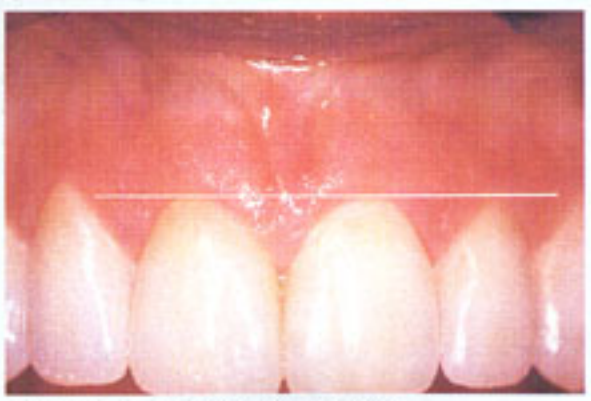


***Figure 11J**—Postoperative 1:1 view.*

***Figures 11K and 11L**—Postoperative full face and smile showing corrected proportions of teeth and harmonious incisal edge position to lower and upper lip and interpupillary horizontal reference lines.*

not display the gingiva and, in full smile, the lip line reached just into the gingival margin at the neck of the teeth. Therefore, there was no demand for perfection in the gingival margin architecture. The preoperative length of the central incisors was maintained in the incisal direction but slightly lengthened through minor gingivectomy in the cervical direction. The incisal position was maintained because of phonetic concerns and because of its desired display of vertical length and esthetic relationship with the lower lip (Figures 11A through 11F).

Treatment Plan

The central incisors were used

as the key to the creation of the smile design. To create a more harmonious incisal edge relationship to the lower lip and interpupillary line, lateral incisors, cuspids, and bicuspids needed to be lengthened. Knowing the desired length of the central incisors, a diagnostic wax-up was done to reproduce a pleasing Golden proportion and broader smile through building out the buccal corridors. The wax-up and subsequent temporization provided the laboratory with a blueprint of the preferred smile design.

Final Result

Postoperative views of the patient clearly show the enhanced incisal edge position relative to the lower lip line and the parallelism to the upper lip line and interpupillary line (Figures 11G through 11L). In addition, the build out of the cuspids and the bicuspids provided a broader, fuller smile, imparting a significant contribution to the overall symmetry and parallelism of the orofacial complex.

Conclusion

As esthetic dentistry and smile design evolve, we must remember that soft tissue does not just mean the gingiva, and hard tissue does not just mean the teeth. Just as a plastic surgeon would seek to provide proportion to a patient's face in a rhinoplasty procedure, so must we, as plastic surgeons of the teeth and gingiva, look beyond the oral cavity and realize the interrelationships that exist in the orofacial complex. We must understand that the quality of our result is a function of our ability to fully perceive the contribution the entities outside the oral cavity have on our smile and smile design.

Acknowledgments

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