



Understanding the Esthetic Evaluation for Success

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ABSTRACT

With any restorative procedure, a thorough evaluation, diagnosis, and treatment plan is essential for a positive outcome. When dealing with esthetic dilemmas, the same holds true. Without a sequential esthetic evaluation, diagnosis, treatment plan, and execution, an acceptable outcome is difficult to predict. The treating clinician should be able to visualize the esthetic problem, visualize the proposed changes, and devise a way to achieve the result while still maintaining mechanically, functionally, and biologically sound principles.

Esthetic Evaluation

The following method of evaluation for esthetics is the author's expressed opinion. Esthetics is subjective and hence there are many concepts that work well.

Incisal Edge Position of the Centrals

The first objective for evaluation is to envision the future positions of the final restorations. In order to facilitate this, the clinician should find a starting point in the evaluation process. A good starting point is the incisal edge position of the upper central incisors at rest. The patient is seated and asked to say the letter "m" followed by relaxation of the lips (Figure 1). The amount of central incisor showing is evaluated and measured. According to Vig et al,¹ the average amount of tooth exposure with the lips at rest in men was less than women. As the age of the patients increased, the amount of incisal edge display decreased, and short upper lips generally displayed more maxillary tooth structure than long lips. The future incisal edge position may be related to the sex, lip length and age although more importantly, how youthful the patient wants to appear, and the patients overall self image, and personality. The less tooth exposure, the older appearing is the smile. Generally, the author's objective is to make his patients look more

youthful. If this is the case, there should be some tooth exposure evident at rest, the more, the more youthful appearing.

Occlusal Plane

The next step in this evaluation process is the occlusal plane. This is done by having the patient smile (Figure 2). The occlusal plane allows evaluation of the whole arch relative to the chosen incisal edge position. The occlusal plane is actually a flat plane derived from the incisal edges of the centrals, bisecting the cusp tips of the canines and continuing posteriorly (Figure 4). What gives the illusion that it is radial in relationship to the lower lip (follows the curvature of the lower lip) is the cant of the maxilla in a sagittal plane (anterior to posterior) (Figure 2).

Generally, the occlusal plane is obtained by paralleling (canine to canine) to the interpupillary line assuming no asymmetries in the eyes (Figure 3). This reference plane is used even if there are inherent irregularities of the lips. The only time the interpupillary plane is not used as a reference is if the eyes are not level. If this is the case, the occlusal plane should be paralleled to the floor by mounting the diagnostic models using an earbow leveled with the floor.



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Figure 1. The incisal edge position at rest is the first critical step in the esthetic evaluation.



Figure 2. Having the patient smile allows visualization of the occlusal plane relationship to the lower lip.



Figure 3. The occlusal plane is achieved by paralleling a line bisecting the cusp tips of the canines and a line bisecting the corners of the eyes.



Figure 4. A line drawn from the incisal edges of the centrals should bisect the cusp tips of the posteriors to create a harmonious occlusal plane. A line perpendicular to the occlusal plane will help establish the facial plane of the incisors.



Figure 5. The midline should be perpendicular to the occlusal plane.



Figure 6. The gingival zenith is the most apical point of the free gingival margin.

Another reference for the occlusal plane is the curvature of the lower lip. The incisal edge positions of the upper teeth should follow the curvature of the lower lip if the objective is to make the patient appear more youthful, assuming no irregularities in the smile. If the objective is to make the teeth appear more age appropriate, it is not uncommon due to wear of teeth for the occlusal plane to be flattened out relative to the lower lip. If this is the case, the plane should parallel the interpupillary line with the incisal edges and cusps equidistant from the lower lip (if the lip is symmetrical).

Facial Plane of the Incisors

A line drawn on the midfacial plane of the incisors should bisect a line drawn on the occlusal plane perpendicu-

larly (Figure 4). Evaluating the facial plane gives an idea if the facial contours of the proposed restorations need to be modified to create the appearance of being perpendicular to the occlusal plane. This can be done by making the cervical contour slightly more pronounced or by tapering the incisal edges lingually (if the teeth are proclined) or by bringing the incisal edges outward (if the teeth are retroclined). Any modifications to the incisal edges of the centrals in a facial-palatal direction should be evaluated functionally and phonetically as well as esthetically (whether the lip support will be adversely affected).

Midline

In an ideal esthetic setting, the maxillary midline should coincide with the midline of the face. In reali-

ty, the verticality of the midline appears to be much more critical than the mediolateral position.² As long as the midline is perpendicular to the occlusal plane and hence the interpupillary plane, the smile can appear balanced (Figure 5). If the midline deviates in verticality from being perpendicular, this can create lack of flow and symmetry to the smile. Generally, the midline is made to line up with the middle of the face and the philtrum of the lip. If a severe mediolateral abnormality exists, orthodontic or orthognathic treatment may be necessary.

Gingival Health and Balance

Successful treatment of the anterior dentition requires both a harmonious integration of hard and soft tis-



Figure 7. The axial inclinations of the teeth should be toward the mesial from an apical-incisal direction. The posterior teeth should flow with the axial inclination of the cuspid to create a smooth transition from anterior to posterior.

sue.³ When evaluating the soft tissue, health and harmonious gingival contours are essential for esthetics. In a healthy situation, the gingival tissue follows the cervical contours of the teeth with the apical extent of the free gingival margin (**gingival zenith**) lying distal to the center of the tooth (**Figure 6**). On the mesial and distal aspects of the teeth (interproximally) the cervical embrasures between the teeth are filled by the scalloping of the tissue forming the papillae. For the appearance of health and beauty, the papillae should fill the cervical embrasures. Balance is achieved with the tissue heights of the centrals and canines at the same level and the tissue heights of the lateral incisor slightly more coronal.

There are subtle variations of this pattern that are acceptable as long as the cervical margin of the contralateral centrals are at the same level, the contralateral canines on either side are close to being at the same level, and the lateral incisors are not cervical to the centrals and canines.

In the esthetic evaluation, final position of the soft tissue will be dictated by the incisal edge position chosen for the occlusal plane. By using the average measurements of 10.4-

11.2 mm for the central incisors⁴⁻⁶ and measuring cervically, the new soft tissue levels can be visualized. If they differ from the present soft tissue levels, the possibility of performing either orthodontics, soft tissue grafting, gingival reshaping, or esthetic crown lengthening for the purposes of leveling the tissues becomes evident. This decision process is based on whether there is a need for root coverage or tooth exposure.

If veneers are being considered, and the tissue needs to be raised cervically to create a harmonious gingival contour, exposure of dentin may indicate the need for a different type of restoration. Ideally for long-term predictability of ceramic veneers, the preparation should remain in enamel due to the documented strong bond to enamel vs. the variability of bonding to dentin.

Arrangement

From clinical experience, when patients present for esthetic changes, they are usually seeking correction of irregularities or mal-alignments. In nature, there is no such thing as perfect symmetry. Although more patients are seeking correction of mal-alignments of their teeth by doing orthodontics, there is still no such thing as perfectly aligned teeth. If our goal is to please our patients yet still make our restorations appear life-like, creating symmetry of the central incisors and making any slight rotations or irregularities in alignment on the laterals or canines can create a pleasing and natural esthetic appearance to our restorations.

Any obvious irregularities in alignment or rotation that create imbalance should be noted by the clinician in the evaluation. If there exists any crowding or mal-alignment that will create a lack of space after alignment

of the teeth, the patient should be informed of the limitations of veneers or crowns to align the teeth or that overlapping may be necessary. If overlapping is not an option, orthodontics may be the best option. Again, only in the diagnostic wax-up phase can the overall arrangement to be assessed as to whether it will create the esthetic goal that the patient and the dentist are trying to achieve.

Another important criteria for esthetic success in arrangement are the position of canines. The canines are important in transitioning the anterior aspect of the arch to the posterior. The more visible the distal aspect of the canine, the wider the anterior segment of the arch will appear, creating a squarer shape to the arch with a loss of a smooth transition from anterior to posterior. Only the mesial half of the canine should be visualized from an anterior perspective (**Figure 6**). Although the golden proportion is a mathematical concept that does not take into consideration dominance, symmetry, and overall subjective creativity, it does emphasize the fact that the canine, viewed from a facial perspective can be seen only from the mesial aspect. The facial aspect of the canine ideally should be made to flow with the posterior facial aspects to create a smooth transition from anterior of the arch to the posterior (**Figure 7**).

Ideally, the heights of contour of all the upper anterior teeth should follow the gingival zenith (distal to the middle of the tooth) with the **axial inclination** (**Figure 7**) from a cervical-incisal direction toward the mesial.

Tooth Dimension and Proportion

Dominance and relative symmetry of the centrals are two of the fundamental parameters for esthetic success⁷ (**Figure 8**). The centrals are the focal



Figure 8. The central incisors should be dominant relative to the other anterior teeth. The incisal embrasures help to define the tooth form and to create individuality to the teeth. The internal characterization and translucency is critical in mimicking nature.

point of the smile and should appear appropriate in size and relatively symmetric. In terms of the overall size and proportion of the teeth, there are studies of average measurements that tend to be useful as guidelines for the dimension of the future restorations.⁸⁻¹⁰ Not only are there many studies that show the average length and width of teeth, but Sterret et al,¹¹ found that the width/length ratios of unworn incisors and canines both fall within 77-85 percent. Centrals and canines have similar crown length with an average of 1-1.5 mm longer than lateral incisors.

Evaluation should include a subjective evaluation of the existing dimension and proportion of the existing teeth and any planned changes. Any severe discrepancies should be noted in the clinical examination. Alteration of the length of the teeth via esthetic crown lengthening or soft tissue grafting will alter overall dimensions and proportions of the final tooth form. Future tooth proportion and dimension can only be determined during the diagnostic wax-up phase of treatment because in reality, the arch form and occlusal relationship will dictate the width of the teeth. Any changes in the length of the teeth as dictated by the

evaluation should be incorporated into the diagnostic wax up. Waxing over the tissue on the diagnostic model to change the crown's length is necessary to visualize if the proposed changes in tooth dimension and contour will be acceptable with a change in the soft tissue contours.

Tooth Contour and Incisal Embrasures

There are three basic shapes of teeth: square, ovoid, and triangular. Although there are three natural tooth forms, all anterior teeth are formed by three facial lobes and one palatal lobe. The conjunction of the three facial lobes create the mamelons. As a result, all incisal edges are rounded in youth. As we age, the teeth wear at varying degrees. This in turn creates a squarer appearance to the incisal edges of the centrals, and flattening of the cusps on the canines. If the objective is to create a more youthful smile and delicate smile, rounder incisal edges and more pointed cusp tips on the canines are necessary and vice-versa.¹²

The **incisal embrasures** (Figure 8) are formed by the interrelationships of the incisal edges of the anterior teeth and the cusp tips of the canines and posteriors. They are important in creating a life-like appearance to any restoration. The interaction of the incisal embrasures with the space between the lower teeth or lower lip and the incisal edges of the upper teeth when laughing (**negative space**) helps to outline and give individuality to the teeth. In youth, with less wear, the incisal embrasures are quite large with the smallest between the central incisors and progressively getting larger as you move in the arch posteriorly (Figure 8). If there has been some wear due to function or parafunction, not only do the teeth wear but the incisal embra-

asures get smaller. If a youthful appearance is the objective, larger incisal embrasures are essential.

Color and Character

In the evaluation step, it is important to determine what types of color changes are necessary for the final restorations. If the color of the final restorations is not going to be changed relative to the existing color of the teeth or only slight modifications in color are required, veneers may be the ideal type of restoration due to their inherent translucency. If a moderate color change is required, it may still be possible with veneers although the technician should be given slides of the preparations and of shade tabs to be able to visualize the areas to be blocked out in the porcelain. If severe color changes are required, either bleaching prior to preparation or choosing a different type of final restoration may be indicated.

Characterization of the teeth such as translucencies, crack lines, etc. on remaining natural teeth should be noted if the veneers are to match them (Figure 8).

Diagnostic Wax up

The diagnostic wax-up phase of treatment is one of the most essential aspects in all of the treatment. It is only through the wax up that all of the alterations that were planned as a result of the esthetic evaluation can be tested. All of the criteria for esthetic success should be implemented in the wax up. If any of the changes are not possible, this is where it will be discovered, and not after preparing the teeth.

Tissue Recontouring

Once the wax up is complete, visualization of the proposed soft tissue alterations are possible. The soft tissue levels may be waxed up on the model so that

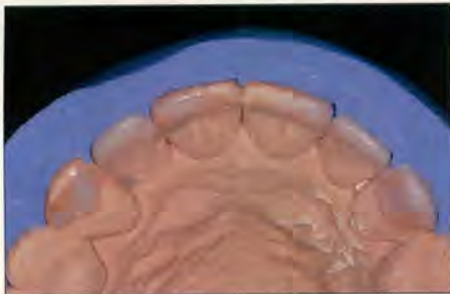


Figure 9. A facial matrix made off the wax up model helps to ensure proper reduction of the facial and interproximal aspect of the preparations.



Figure 10. A palatal matrix made off the wax up model helps to ensure proper incisal edge reduction.



Figure 11. A full matrix of the wax up allows fabrication of the provisional restorations.

the proportion and dimension of the teeth can be evaluated. If even more accuracy is required than just visualization, a surgical stent can be made from a model of the wax up by making a vacuumform cut to the desired soft tissue levels. By use of the wax up, the modifications can be made intraorally to idealize the soft tissue form whether through esthetic crown lengthening or connective tissue grafting.

Provisionalization and Final Impressions

Using a facial matrix made off of the diagnostic wax-up model to check preparation depth both facially and interproximally, proper reduction of the preparations can be ensured (Figure 9). A palatal matrix helps to achieve proper incisal edge preparation (Figure 10), and a full contour matrix of the diagnostic wax up helps to fabricate the provisionals. By loading the matrix with acrylic and seating the matrix on the preparations, the contours of the wax up will be formed in acrylic (Figure 11). Only by virtue of the provisionals can the esthetic alterations be visualized and checked. The wax up may look great on the model but only by visualizing the provisionals in the mouth can a true evaluation be made.

Any final contour changes should be made to the provisionals intraorally

so that they are as close as possible to the desired width, length, contour, and arrangement of the final restorations. Once the contours are idealized, the provisionals should be measured to verify adequate preparation and only once ideal, the final impression is taken. Once the provisionals are cemented, alginate impressions are taken to produce stone casts of the provisionals in the mouth.

Laboratory Considerations

All of the models are cross mounted so that the provisional model is transferable with the preparation model. Indexes made off of the provisional model help transfer the information from the provisionals to the final restorations.

The final color, character, and texture are all defined in the final restorations. Photos are made of the preparations and shade tabs so the laboratory technician can determine if any block out any necessary areas to achieve the desired color. Internal characterization is paramount to success of any restoration. Teeth have varying amounts of translucency and internal characterization. In the older patient, crack lines are a very common occurrence. All of these minor characterizations help to lend a natural appearance to the final restorations. Surface texture is also important.

Teeth erupt into the mouth with a very complex surface morphology of horizontal lines (lines of retzius) and vertical grooves (between the lobes). This surface texture reflects and deflects light and hence makes the teeth appear brighter. Due to erosion and abrasion over time, the surfaces of older teeth tend to display less surface texture. This allows more light to be absorbed and hence lower value to the teeth. Surface characterization is based on matching adjacent teeth or the by overall objective of youthfulness or aging.

Case Presentation

A 45-year-old patient presented to the office for a consult regarding her oral condition (Figure 12). She had a history of numerous restorative procedures (crowns and large composite fillings) in all of the teeth except the upper central incisors. She expressed unhappiness with the way her mouth looked and wanted a long-term, natural appearing esthetic solution that would make her appear more youthful. Upon evaluation, it was determined she had decay on almost all of her teeth and under her old restorations, necessitating a full-mouth rehabilitation. The patient was examined thoroughly from an extraoral, intraoral, and radiographic aspect. The objectives of treatment were to create a functionally, mechanically, and biologi-



Figure 12. A facial view of the patient at presentation.



Figure 13. With the lips at rest, the patient showed 5 mm of tooth structure.



Figure 14. The smile revealed a disharmony in the arch form and the occlusal plane.



Figure 15. From an intraoral view, the gingival imbalance due to recession was visible. The arch form was V-shaped due to the lingual position of the canines. The canines were short relative to the occlusal plane. All of the teeth except the central incisors were stained and dark due to previous restorations.



Figure 16. Although the teeth were proportional relative to each other, the recession and wear created a lack of proportion of the teeth individually, necessitating gingival correction and lengthening of the worn teeth.

moderate amounts of gingival recession (Figure 15). Because the teeth were long already and because the canines needed to be lengthened to level the occlusal plane, the need for a root coverage procedure was indicated to create proportional width/length ratios. Another indication for root coverage was that the centrals and laterals were going to be restored with veneers. In order to create a finish line in enamel, root coverage was essential.

Arrangement

The arch form in the cuspid area did not flow with the posteriors aspect of the arch because both canines were tipped palatally on both sides while the first bicuspid were slightly buccal (Figure 15). This gave the illusion of a V-shaped arch rather than the desired U-shaped arch.

Tooth Dimension and Proportion

The distance from the distal aspect of the incisal edge of the central incisors up to the CEJ's created a proportionate dimension and dominance to the central incisors. Both lateral incisors were worn and although the upper left lateral was an appropriate length it was not appropriately shaped. The upper right lateral incisor was too short relative to the left. The canines needed to be lengthened to correct the occlusal plane (Figure 16).

cally sound rehabilitation while making the patient look better and more youthful. All ceramic Procera crowns were planned for the posterior teeth and porcelain veneers for the incisors.

The **esthetic evaluation** revealed the following:

Incisal edge position

At rest, the patient showed approximately 5mm of tooth structure with wear on the distals of the centrals (Figure 13). This created a V-shaped incisal edge relationship between the central incisors that the patient did not like. The distal aspects of the centrals were subjectively determined to be the correct length for the future incisal edge position because the centrals were actually a bit long relative to the width.

Occlusal Plane

When the patient was asked to smile, the occlusal plane was evaluated (Figure 14). Although the posterior aspect of the occlusal plane was fairly adequate, both canines were short relative to the occlusal plane (Figure 15).

Facial Plane of the Incisors

The facial plane was nearly perpendicular relative to the occlusal plane.

Midline

The upper midline was vertical and hence adequate in positioning (Figure 12).

Gingival Health and Balance

From an intraoral view, it was evident that the patient had generalized



Figure 17. Intraoral evaluation of the provisionals revealed a more harmonious tissue contour, tooth contour, dimension, occlusal plane, and arrangement.



Figure 18. An evaluation of the provisionals with a smile revealed a more harmonious arch form and symmetry.



Figure 19. The length of the final restorations at rest were appropriate for the patient.



Figure 20. The occlusal plane was made level to the eyes.



Figure 21. The occlusal plane was radial in relationship to the lower lip.



Figure 22. The facial plane of the incisors was perpendicular to the occlusal plane. The incisal edge configuration along with the incisal embrasures gave a feeling of youthfulness.

Tooth Contour and Incisal Embrasures

Because the teeth were worn, the incisal edges were flat, creating an older appearance to the teeth. (Figure 16). As a result of wear, the embrasures were small as well. The objective was to create a more youthful smile and therefore, rounder incisal edges and larger incisal embrasures would be appropriate.

Color and Character

All of the teeth other than the two centrals were dark in color due to previous restorations and decay (Figure 15). Due to the severity of the decay, the posterior teeth needed crowns. The lateral incisors and the centrals were restorable via the use of porcelain veneers.

From the esthetic evaluation, a wax up with all of the proposed changes was made. The patient went to see the

periodontist for connective tissue grafting of the upper and lower arches (wherever needed) along with a coronally positioned flap to cover the exposed root surfaces. After three months of healing, a wax up was completed on a new diagnostic model reflecting the improved tissue relationship. The provisionals were made using the matrix made from the diagnostic model and evaluated functionally and esthetically (Figures 17 and 18). With the patient's approval, the final impressions were taken and the case was finished.

From the final photographs, one can see the esthetic objectives were achieved to create a harmonious and balanced smile:

■ At rest, the patient showed an adequate amount of tooth structure creating a youthful look (Figure 19).

■ When smiling, the occlusal plane was made level to the eyes with a radial relationship to the lower lip (Figures 20 and 21).

■ The facial plane of the incisors was maintained perpendicular to the occlusal plane (Figure 22).

■ There was a healthy, pleasing, and balanced symmetry to the soft tissue creating teeth of the same length on either side of the midline (Figure 23).

■ The arch form was widened in the anterior segment. The canines were brought out facially and the bicuspid's lingually to create a smooth transition from the anterior segment to the posterior segment of the upper arch (Figure 21).

■ The teeth were made proportional with a pleasing symmetry (Figure 21).

■ The incisal edges of the centrals



Figure 23. A facial view of the soft tissue revealed a healthy, balanced, and harmonious gingival contours along with a pleasing symmetry in arrangement. The teeth were made brighter while still maintaining a realistic appearance by incorporating internal effects and translucency in the porcelain.



Figure 24. Lateral view of the final smile.

and lateral incisors were made rounder, hence more youthful and delicate (Figures 23 and 24).

■ The Incisal embrasures were opened to create individuality and a sense of reality to the restorations (Figure 22).

■ The teeth were made whiter, brighter and hence more youthful (Figure 23).

■ Translucency and crack lines were incorporated into the restorations to create an illusion of reality (Figure 23).

Conclusion

Esthetic predictability in any restorative procedure can make our dental careers much more enjoyable and rewarding. It would be nice to be able to predictably fabricate beautiful restorations. By consistently following a step-by-step protocol, the chances of success are greatly enhanced. Skipping an important step such as the wax up and provisionalization will ultimately lead to failure. Of critical importance is that knowledge, ability, and artistic flair of the laboratory technician. Not only should he or she know how to transfer all of the vital information obtained from the mouth (provisionals) via in-

dexes, but be able to create a life-like replica in the ceramics. It goes without saying that long-term success demands that the esthetic alterations should fall within the function, mechanical, and biologic principles. **CDA**

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References / 1. Vig RG, Brundo GC. The kinetics of anterior tooth display. *J Prosthet Dent* 39:502-4, 1978.

2. Frush JP, Fisher RD, The dynesthetic interpretation of the dentogenic concept. *J Prosthet Dent* 8:558, 1958.

3. Shavell HM, The periodontal-restorative interface in fixed prosthodontics: Tooth preparation, provisionalization and biologic final impressions. Part II. *Pract Periodontics Aesthetic Dent* 6:33-4, 1994.

4. Shillinburg HT, Kaplan MJ, Grace CS, Tooth dimensions - a comparative study. *J South Calif Dent Assoc* 40:830, 1972.

5. Bjorndal AM, Henderson WG, Skidmore AE, Kellner FH, Anatomic Measurements of human teeth extracted from males between the ages of 17 and 21 years. *Oral Surg Oral Med Oral Pathol* 38:791, 1974.

6. Worlfel JB, Dental Anatomy: Its relevance to Dentistry, ed 4, Philadelphia: Lea & Febiger, 1990.

7. Lombardi RE, The principals of visual perception and their clinical application to denture esthetics. *J Prosthet Dent* 29:358-82, 1973.

8. Shillinburg HT, Kaplan MJ, Grace CS, Tooth dimensions - a comparative study. *J South Calif Dent Assoc* 40:830, 1972.

9. Bjorndal AM, Henderson WG, Skidmore AE, Kellner FH, Anatomic Measurements of human

teeth extracted from males between the ages of 17 and 21 years. *Oral Surg Oral Med Oral Pathol* 38:791, 1974.

10. Worlfel JB, Dental Anatomy: Its relevance to Dentistry, ed 4, Philadelphia: Lea & Febiger 1990

11. Sterret JD, Oliver T, Robinson F, Forston W, Knaak B, Russell CM, Width/length ratios of normal clinical crowns of the maxillary anterior dentition in man. *J Clin Periodontol* 26:153-7, 1999.

12. Frush JP, Fisher RD. How Dentogenic Restorations interpret the sex factor. *J Prosthet Dent* 6:2:160-72, 1956.

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