Predictable Esthetics through Functional Design: The Role of Harmonious Disclusion

BRIAN S. VENCE, DDS*

ABSTRACT

The goal of this clinical report is to describe and illustrate the principles for achieving a predictable esthetic result for patients with worn incisal edges by creating a harmonious angle of disclusion. Patients can create an esthetic problem from altered tooth form and tooth migration, caused by worn incisal edges resulting from parafunctional activity. This presents substantial challenges to the restorative dentist, paramount among them, achieving longevity of porcelain or composite bonded restorations used in an esthetic reconstruction. Although a number of therapies are available to provide esthetic improvement, the predictability in the continuing presence of the parafunction that caused the esthetic problem is in doubt. Altering the incisal edge position for esthetics and achieving a harmonious angle of disclusion, though, is a clinical approach that may substantially reduce this risk.

CLINICAL SIGNIFICANCE

An angle of disclusion in harmony with a patient's envelope of parafunction reduces load on the anterior teeth and therefore may help reduce failure on the restored anterior teeth.

(*J Esthet Restor Dent* 19:185–192, 2007)

INTRODUCTION

Parafunction poses a risk for any type of esthetic or complete reconstruction.[1] If tooth structure has been worn away by parafunction and a tooth is restored without addressing the patient's parafunctional envelope of function, one of two possibilities may exist: new tooth form will dictate new and improved function, or old parafunction will compromise the survival of the new tooth form. Because engrams of muscle memory are difficult to change, parafunction that persists may cause the catastrophic failure of a restoration just as it caused the natural dentition to be worn.[1–3]

Given that it is impossible to predict in which patients will form dictate new function and in which ones will form be compromised by old parafunction, relying on a new form alone to alter the old parafunction is unpredictable. However, when incisal edges have been reduced by parafunction, predictability can be increased and restorative failure can be reduced by creating a permissive anterior guidance and a more harmonious angle of disclusion, in which the horizontal and vertical overlap are altered so that anterior tooth loading is reduced and esthetic change is accomplished within the patient's parafunctional envelope of function.[1]

Private practice, 700 Willow Lane G, West Dundee, IL 60118

DOI 10.1111/j.1708-8240.2007.00096.x

BACKGROUND

Treatment plans for esthetic restoration of patients with worn incisal edges vary and often lack predictability, with mixed success rates based on material choice and location in the mouth.[4,5]

Tooth restoration with a porcelain or composite bonded restoration is predictable when bonded to enamel[5] and can improve tooth esthetics. However, it may create a short appearance of the tooth if tooth migration caused by compensatory eruption resulting from wear from the patient's parafunction is ignored. In these cases, esthetic crown-lengthening techniques to produce a more esthetic crown length can be performed.[6] Without orthodontics to reposition the cementoenamel junction of the tooth, the crown-lengthening procedure will expose tooth root surfaces in the process. Because the bond-to-dentin interface has been found to be less predictable than bond-to-enamel interfaces, the restorative outcome with porcelain or composite bonded restorations on dentin can be, in turn, a less predictable restoration.[7] Complete crowns are a third restorative option, but require more aggressive tooth preparation and may compromise the structural integrity and biological health of the dentition. Furthermore, adding length to the teeth may improve esthetics, but if the resulting dental envelope of function is more restrictive than the parafunctional envelope of function, force is increased on the restored anterior teeth and the likelihood of restorative failure increases.[1,8]

A predictable alternative to creating a more restrictive dental envelope of function is to make a dental envelope of function in harmony with the patient's parafunctional envelope of function. This involves creating a harmonious angle of disclusion based upon consideration of the following four elements: esthetics and parafunction, anterior tooth loading, horizontal and vertical overlap, and laboratory communication.

Several studies form the basis for reducing load on teeth with anterior guidance during excursive movements. Manns demonstrated that anterior tooth contact in centric relation has an inhibitory effect on the temporalis and masseter muscles and that posterior tooth contact overrides anterior inhibition.[9] Manns also showed that canine guidance provides less muscle activity than group function.[10] Williamson and Lundquist demonstrated that balancing interferences increased muscle activity for group function or canine rise, and the flatter the angle of anterior guidance, the lower the muscle activity in excursive movements.[11] Mansour and Reynik found that, biomechanically, bite force varied by a factor of one to nine from the anterior teeth to the posterior teeth, with the average human generating 22.5 pounds of force in the anterior and 202.5 pounds in the posterior.[12] In Weinberg's mathematical study of the relationship of the cuspal angle to the force placed on a dental implant, the author calculated that for every 10-degree change in the cuspal angle from 0 to 40 degrees, there was a 32% change in tortional stress at the level of the abutment.[8] Kokich described that the least amount of vertical overlap needed to create posterior disclusion is determined by the posterior cuspal height.[13] The guiding principle for predictability established by this research is to create the flattest angle of disclusion possible in the anterior that still allows posterior disclusion.

There are three ways to change the angle of disclusion by altering the vertical and horizontal overlap: altering the occlusal vertical dimension, altering the maxillary incisor tooth position, and altering the mandibular incisor tooth position.

In order to determine how to best influence the angle of disclusion, it is necessary to determine first if there is a true loss of anterior vertical dimension of occlusion (VDO) or an apparent loss resulting from anterior tooth migration, also termed aberrant anterior tooth

position. Patients with a decreased VDO have *equal* amounts of wear in the anterior and posterior dentition. Because only posterior teeth determine vertical dimension, increasing the VDO in such cases is the most conservative manner to flatten the angle of disclusion as length is restored to the worn dentition.

In patients with aberrant anterior tooth positions, there is an *unequal* amount of wear between the anterior and posterior teeth. Often, there is little or no wear in the posterior teeth. Restoring these patients' teeth by increasing the VDO will result in unnecessary restorative dentistry to treat the true etiology of the patients' problems—tooth migration. Orthodontics, used to create more ideal gingival levels, create a more ideal interincisal angle, and a more ideal horizontal overlap–vertical overlap relationship results in a flatter angle of disclusion allowing minimally invasive restorative dentistry (Figures 1 and 2).

Spear has introduced a protocol[14] for diagnosing aberrant anterior tooth position, such as in the patient's case illustrated in Figures 3 and 4. The diagnosis is made under Spear's protocol after analyzing seven elements:

1. relationship of the maxillary incisor to the face
2. maxillary incisal inclination
3. relationship of the maxillary occlusal plane to the incisal plane
4. maxillary gingival levels
5. mandibular incisal inclination
6. relationship of the mandibular posterior occlusal plane to the incisal plane
7. mandibular gingival levels

Proper diagnosis of the patient's esthetic and functional condition enables the dentist to inform the patient of the treatment option that involves the least amount of restorative dentistry and maximizes predictability prior to patient consent to treatment.

CLINICAL REPORT

A 40-year-old female patient requested a "smile makeover," such as those seen on current makeover shows on television. In this case, the patient's teeth were somewhat shortened because of wear from a constricted and vertical anterior chewing pattern, gingival display

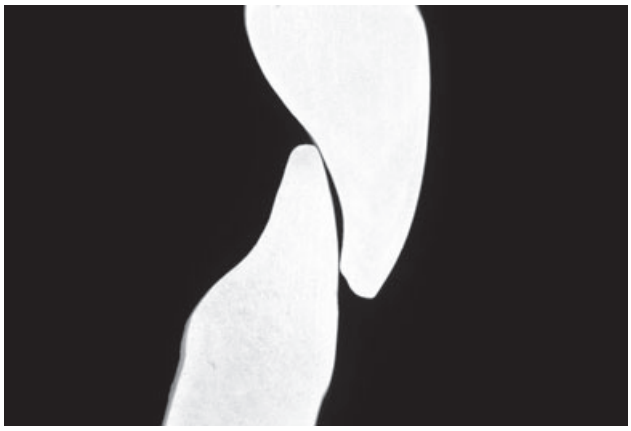

Figure 1. Schematic representation of deep vertical overlap and very little horizontal overlap creating a steep angle of disclusion.

Figure 2. A schematic representation of a more ideal vertical overlap–horizontal overlap relationship creating a shallow angle of disclusion.

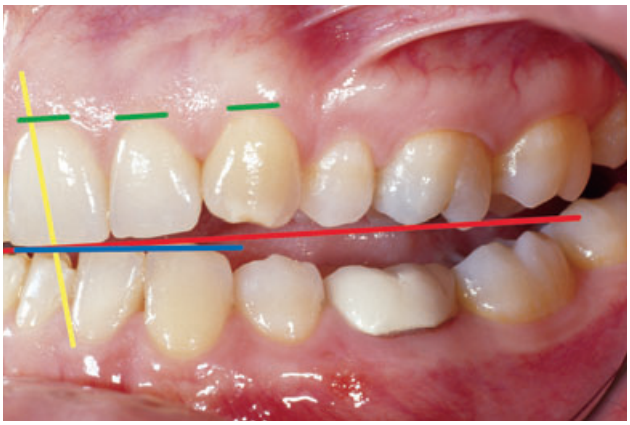

Figure 3. Maxillary elements for diagnosing aberrant tooth position: maxillary incisal edge position (blue line); maxillary incisor inclination (yellow line); maxillary incisal-occlusal plane (red line); maxillary gingival levels (green line).

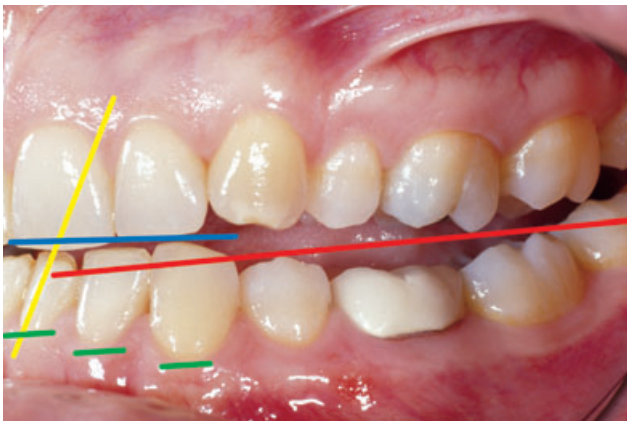

Figure 4. Mandibular elements for diagnosing aberrant tooth position: mandibular incisal edge position (blue line); mandibular incisor inclination (yellow line); mandibular incisal-occlusal plane (red line); mandibular gingival levels (green line).

Figure 5. Preoperative active smile demonstrating anterior tooth wear, excessive gingival display, and an asymmetric smile.

Figure 6. Preoperative maxillary incisal edge position and ideal 2- to 4-mm display in repose. This photo is useful in relating the maxillary incisor position to the face.

was slightly excessive, and the gingival display was somewhat asymmetrical because of a hypermobile lip (Figure 5).

In repose, the patient showed the ideal 2- to 4-mm of display for a person her age[15] (Figure 6), but an oblique smile revealed reclined maxillary and mandibular anterior teeth, a severe vertical overlap, and a steep angle of disclusion (Figure 7). The patient requested restoration with 20 veneers (upper and lower porcelain bonded restorations from molar to molar excluding four premolars, which had been extracted during a previous orthodontic treatment) to make her smile "more dynamic, bright, and full."

Examination of the patient revealed an aberrant anterior tooth relationship (Figure 3 and 4) resulting from

Figure 7. Preoperative oblique smiling photo illustrating reclined incisors, deep vertical overlap, and a steep angle of disclusion.

Figure 8. Postorthodontic photo that shows the "working" composite used during orthodontics to visualize proper tooth form.

compensatory eruption caused by wear from a vertical chewing pattern, which led to wear of the mandibular incisors that was concealed by the severe vertical overlap. Previous orthodontic treatment had solved the Class II excessive horizontal overlap issue by erupting and reclining the maxillary incisors and, oddly, the mandibular incisors. However, the patient had an unesthetic tooth display that was self-diagnosed as needing "veneers." Because there was insufficient space for the porcelain bonded restorations and poor tooth angulation for esthetics, and because the goal was to perform the least amount of dentistry possible to achieve the esthetic and functional result, the patient was referred to an orthodontist. The orthodontist's goal was to align gingival levels, upright the maxillary and mandibular incisors, and improve the incisal angle. The orthodontist added composite to help visualize the correct tooth form and position. Space for restorations was created by intruding and uprighting the worn and migrated teeth and developing the correct incisal angle (Figure 8).

After 18 months of orthodontics, the patient returned for tooth restoration. The patient's teeth were equilibrated in a centric relation in order to achieve a true horizontal overlap–vertical overlap relationship, minimize muscle activity, and, more favorably, distribute occlusal load on the teeth. Trial therapy, which involved replacing the composite restorations used during orthodontics with a more esthetic and functional composite restoration, was discussed with the patient. It was agreed that the composite restoration would be evaluated over time to determine if its longevity was acceptable as a definitive restoration, how it would be maintained with the patient's parafunctional envelope of function, and whether porcelain bonded restorations or crowns needed to be considered as the definitive restoration to provide increased strength of the restorative material. Instead of restoring the teeth with 20 veneers, six maxillary anterior composite restorations were placed on the incisal edges from teeth #6 to 11, and three mandibular composites were placed on the mesial-distal incisal-facial edges of teeth #24 to 26 (Renamel, Cosmedent, Chicago, IL, USA). The corrected gingival levels, incisal angle of the maxillary and mandibular incisors, and lip support filled out the smile esthetically and eliminated the excessive gingival display (Figures 9 and 10). Harmony was restored to the incisal plane and the occlusal plane, eliminating the deep vertical overlap. This was achieved by correcting the gingival levels and

Figure 9. Postoperative active smile demonstrating improved esthetics by maintaining the maxillary incisal edge position, restoring worn tooth structure, and eliminating the excessive gingival display by orthodontically intruding the maxillary incisor to the correct gingival level.

Figure 10. Postoperative oblique smile photo showing the correct angulation of the proclined maxillary incisor to improve horizontal and vertical overlap and demonstrating improved lip support. Compare to the preoperative oblique smile photo in Figure 7.

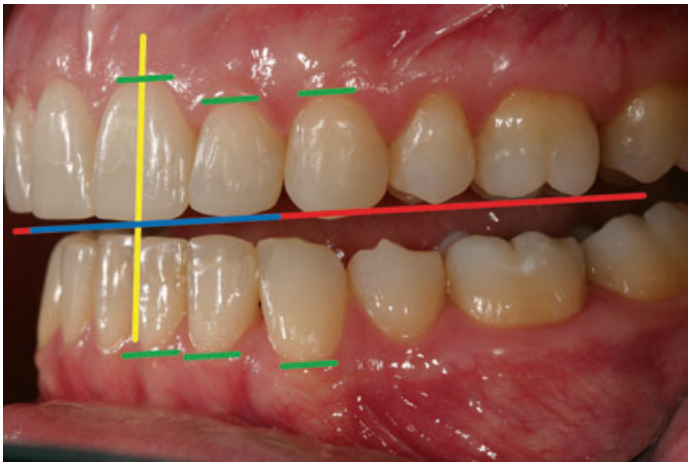

Figure 11. Postoperative photo to evaluate the correction of aberrant tooth position elements. Note that the correct facial angulation of the maxillary and mandibular incisors should intersect their respective occlusal planes at right angles, and the incisal plane of the restored incisors should be at the same level as the posterior occlusal plane.

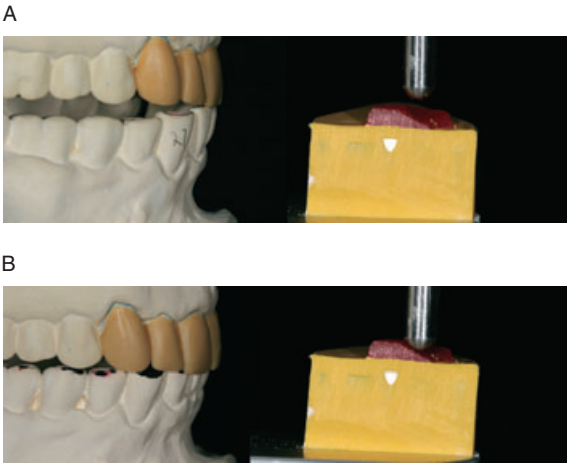

Figure 12. A, After the diagnostic wax-up incorporating the desired esthetic changes, the angle of disclusion is increased as shown by the incisal pin not contacting the custom incisal guide table fabricated from the worn preoperative cast. B, The distance the guide pin is from the guide table is the distance the mandibular incisors need to be intruded or shortened to preserve the envelope of parafunction and maintain a harmonious angle of discussion.

giving the appearance that vertical dimension has increased when, in reality, a more ideal horizontal overlap–vertical overlap relationship and a shallower angle of disclusion had been created.

Because direct composites were used for the restoration, communication with the laboratory was not a factor. When restorations are fabricated in the laboratory, preoperative diagnostic casts are mounted in a centric relation on a facebow articulator and a custom incisal guide table is used to maintain the angle of disclusion (Figures 11 and 12). Provisionals are fabricated from a diagnostic wax-up and used as trial therapy instead of the composite restorations used in the previous case. The definitive restorations are fabricated using the esthetic and functional parameters developed in the diagnostic provisionals and transferred to the laboratory via the custom incisal guide table.

CONCLUSION

Even if form alters function in cases in which parafunction is a causative factor, relying on form alone to alter pathological function can result in an unacceptable restorative failure rate. Altering gingival levels, correcting the incisal angle, and minimizing the vertical and horizontal overlap to create a harmonious angle of disclusion is a clinical approach that restores esthetics by more predictably altering function. In patients with worn incisal edges resulting from parafunctional activity, this approach provides an esthetic and functional result in which tooth form has been tested via trial therapy and has been demonstrated to work most harmoniously with the patient's parafunction.

DISCLOSURE

The author does not have any financial interest in any of the manufacturers whose products are mentioned in this article.

REFERENCES

1. Spear FM. Chapters 31 and 32. In: McNeil C, editor. Science and practice of occlusion. Chicago (IL): Quintessence Publishing Co. Inc.; 1997. pp. 421–34, 437–56.
2. Holmgren K. Effect of a full-arch maxillary, occlusal splint on parafunctional activity during sleep in patients with nocturnal bruxism and signs and symptoms of CMD. J Prosthet Dent 1993;89:293–7.
3. Ekfeldt A, Karlsson S. Changes of masticatory movement characteristics after prosthodontic rehabilitation of individuals with extensive tooth wear. Int J Prothodont 1996;9:539–45.
4. Spear F. The metal-free practice: Myth? Reality? Desirable goal? J Esthet Dent 2001;13:59–67.
5. Friedman M. A 15-year review of porcelain veneer failure: a clinician's observations. Compend Contin Educ Dent 1998;19(6):625–36.
6. Sterrett JD, Oliver T, Robinson F, Fortson W, et al. Width/length ratios of normal clinical crowns of the maxillary anterior dentition in man. J Clin Periodont 1999;26(3):153–7.
7. Fissore B, Nicholls J, Yuodelis R. Load fatigue of teeth restored by a dentin bonding agent and a posterior composite resin. J Prosthet Dent 1991;65:80–5.
8. Weinberg L, Kruger B. A comparison of implant/prosthesis loading with four clinical variables. Int J Prosthodont 1995;8:421–33.
9. Manns A, Mirralles R, Valdivia J, Bull R. Influence of variation in anteroposterior occlusal contacts on electromyographic activity. J Prosthet Dent 1989;61: 617–23.
10. Manns A, Chan C, Miralles R. Influence of group function and canine guidance on electromyographic activity of elevator muscles. J Prosthet Dent 1987;57(4): 494–501.
11. Williamson EH, Lundquist DO. Anterior guidance: its effect on electromyographic activity of the temporal and masseter muscles. J Prosthet Dent 1983;49(6): 816–23.
12. Mansour R, Reynik R. In vivo occlusal forces and moments: I. Forces measured in terminal hinge position and associated moments. J Dent Res 1975;54(4):114–20.
13. Kokich VG. Excellence in finishing: modifications for the perio-restorative patient. Semin Orthod 2003;19(3):184–203.
14. Spear FM. Treatment planning esthetics and occlusion in patients with aberrant anterior relationships. AARD Annual Meeting, February 26, 2005, Chicago (IL).
15. Vig RG, Brundo GC. The kinetics of anterior tooth display. J Prosthet Dent 1978;39:502–4.

Reprint requests: Brian S. Vence, DDS, 700 Willow Lane G, West Dundee, IL 60118. Tel.: 847 426 1522; Fax: 847 426 1581; e-mail: Vencedds@msn.com