

Principles of cosmetic dentistry in orthodontics: Part 1. Shape and proportionality of anterior teeth

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In the past decade, there has been a remarkable upswing in interdisciplinary collaboration between dentists, orthodontists, and periodontists in smile enhancement, and now an entire field of “cosmetic periodontics” has evolved in collaboration with cosmetic dentistry. Contemporary orthodontic smile analysis is generally defined in terms of (1) vertical placement of the anterior teeth to the upper lip at rest and on smile (adequate incisor display but not too gummy), (2) transverse smile dimension (buccal corridors), (3) smile arc characteristics, and (4) the vertical relationship of gingival margins to each other. Through the interaction with these other disciplines and the knowledge gained, we have expanded our diagnosis of the smile to further refine the finishing of anterior esthetics for our patients.

As our interaction with cosmetic dentistry has increased, we have become very aware of what standards guide the dentist who strives for an excellent smile. Through cosmetic bonding and laminate veneers, the dentist can control tooth shape by adding or taking away from the tooth, crown, or laminate. As orthodontists, we have generally limited our tooth-reshaping efforts to incisal edge “dressing.” The purpose of this article is to examine some cosmetic ideas and present new ways in which we can improve the smiles of our patients. In Part 1, I will define and illustrate how these principles are applied to improve the cosmetics of orthodontic patients. In Part 2, my coauthor and I will review the new laser technology available for reshaping soft tissues, and, in Part 3, we will discuss the clinical use of those lasers.

PRINCIPLES OF COSMETIC DENTISTRY

The literature on cosmetic dentistry contains excellent definitions of desirable characteristics of tooth shape and proportions, gingival esthetic characteristics, and what constitutes esthetic teeth and gingival relationships. These characteristics include (1) tooth proportionality, (2) contacts, connectors, and embrasures, and (3) gingival characteristics.

Tooth proportionality— height and width

Many authors point out the need for achieving proportions in the smile that harmonize with the face,¹ and the golden proportion is suggested as a guide.^{2,3} The most commonly reported maxillary incisor height-width relationships are illustrated in Figure 1. The ideal maxillary central incisor should be approximately 80% width compared with height,⁴ but it has been reported to vary between 66% and 80%.⁵ A higher width/height ratio means a squarer tooth, and a lower ratio indicates a longer appearance. Many smiles exhibit disproportionality, so that these measurements should not be taken as an absolute rule. The ranges of height and width are important to note,⁶⁻⁹ because the disproportionality of a tooth can then be evaluated with regard to what parameter is at fault and in need of improvement. This concept is illustrated in Figure 2, which shows a tooth that is virtually square. The basic question in assessing its disproportion is whether it is too short or too wide. Its width is 8.0 mm, and its height is 8.5 mm. When compared with the range of ideals reported in Figure 1, the width is within normal range, but the height is significantly short. The tooth disproportion is due to short clinical crown height (either inherent or secondary to attrition), incomplete passive eruption, or vertical gingival encroachment. The corresponding solutions to the tooth height problem are all different, including bonding or laminates to increase the length of the tooth, awaiting completion of passive eruption, or periodontal crown lengthening.

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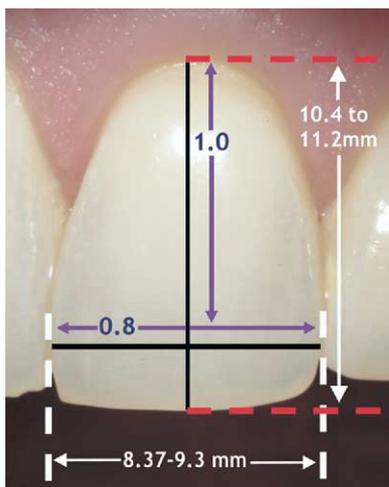


Fig 1. Ideal maxillary central incisor proportion is approximately 80% width compared with height, with ranges as shown.

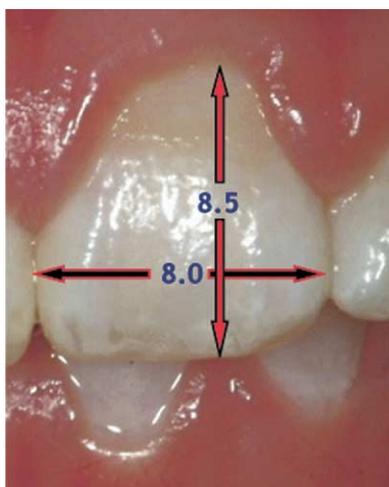


Fig 2. Is this incisor too short or too wide? Crown width is 8.0 mm, within normal range, but height is 8.5 mm, significantly shorter than acceptable range.

Contacts, connectors, and embrasures

The elements of tooth contacts, connectors, and embrasures can be of real significance in planning the treatment of the smile.^{10,11} Contacts (interdental contact points) are defined as the exact place that the teeth touch (what makes floss snap). The connector (also referred to as the interdental contact area) is where the incisors and canines “appear” to touch. The contact points progress apically as the teeth proceed from the midline to the posterior. The connector height is greatest between the central incisors and diminishes from the central to the posterior teeth. The embrasures (the

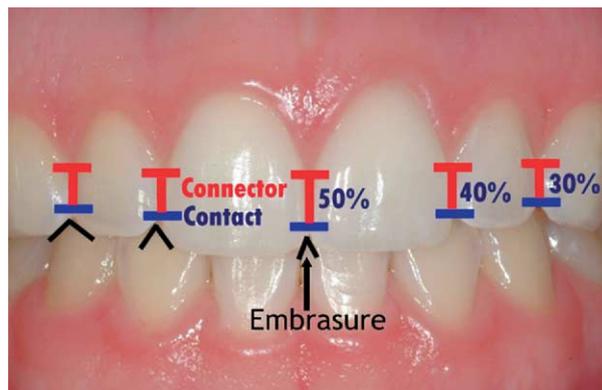


Fig 3. Contact between anterior teeth is where teeth actually touch; connector is where teeth appear to touch. Appropriate ratio for connector between central incisors is 50% of tooth height; ratio for central and lateral incisor connector is 40% of central incisor height; ratio for lateral incisor and canine connector is 30% of central incisor height. Embrasures are smallest between central incisors and grow larger as they progress posteriorly in dentition.

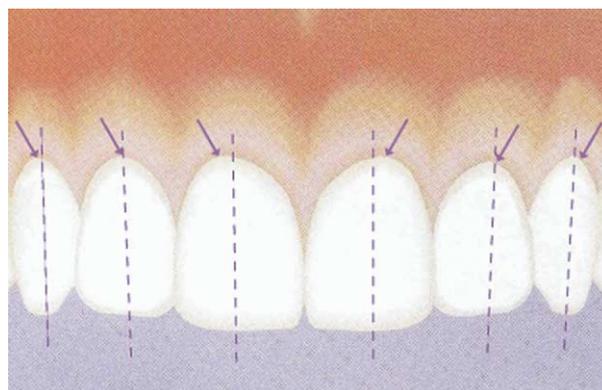


Fig 4. Gingival shape refers to curvature of gingival margin of tooth. Gingival zenith (most apical point of gingival tissue) is distal to longitudinal axis of maxillary central incisors and canines. Gingival zenith of maxillary lateral incisors should coincide with their longitudinal axis.

triangular space incisal to the contact) ideally are larger as the teeth progress posteriorly. Figure 3 illustrates these relationships.

Gingival esthetics

Two concepts of cosmetic dentistry that are important to the final esthetic outcome of orthodontic patients are *gingival shape* and *gingival contour*.

In cosmetic dentistry, care is taken in the assessment of the gingival architecture for the anterior teeth

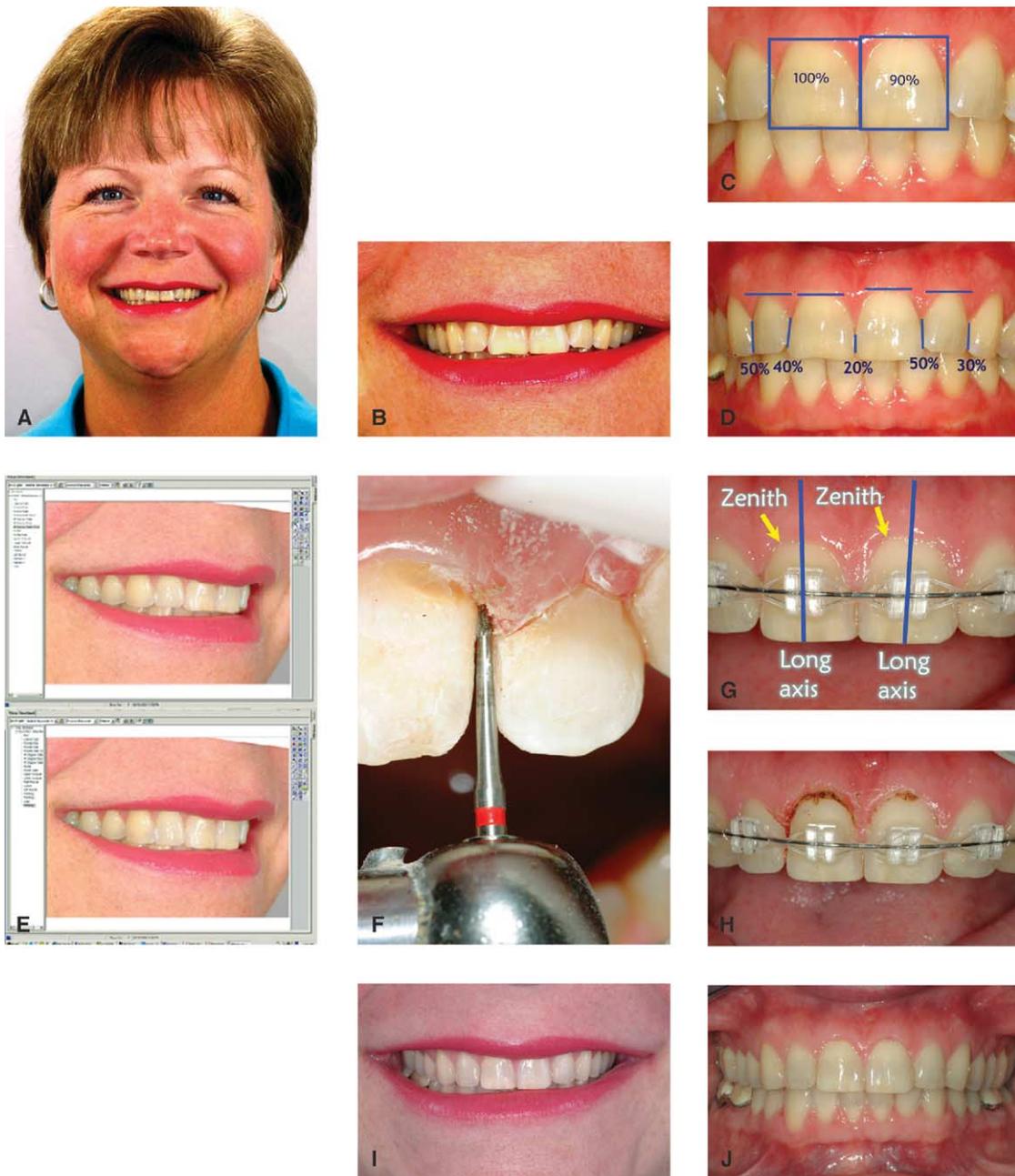


Fig 5. Patient sought treatment for an “improved smile.” **A**, pretreatment photo; **B**, smile characterized by incomplete incisor display (characteristic of aging smile) and flat smile arc; **C**, central incisor heights and widths were disproportionate—maxillary right central incisor had 1:1 height/width ratio (100%) but left was 9:10 (90%); **D**, connector lengths were 20% between central incisors, 50% between central and lateral incisors, and 50% between lateral incisors and canines. Gingival heights were also vertically disparate; **E**, imaging session helped visualize proposed extrusion of maxillary anterior teeth and resulting improvement of smile arc and tooth display; **F**, bur used to reduce mesiodistal width of incisors and lengthen connectors where needed. This sometimes requires subgingival recontouring; **G**, zenith of right central incisor was too distal, whereas zenith of left central incisor was too mesial; **H**, immediately after a soft tissue laser used to reshape gingival contours for better zenith location and to improve crown heights; **I**, final smile characterized by increased tooth display, improved smile arc, and better tooth proportion; **J**, intraoral image of final result, with improved tooth shape and gingival contour.

to have certain characteristics. Gingival shape refers to curvature of the gingival margin of the tooth, determined by the cemento-enamel junction and the osseous crest. According to the accreditation criteria for the American Academy of Cosmetic Dentistry,¹² "The gingival shape of the mandibular incisors and the maxillary laterals should exhibit a symmetrical half-oval or half-circular shape. The maxillary centrals and canines should exhibit a gingival shape that is more elliptical. Thus, the gingival zenith (the most apical point of the gingival tissue) is located distal to the longitudinal axis of the maxillary centrals and canines (Fig 4). The gingival zenith of the maxillary laterals and mandibular incisors should coincide with their longitudinal axis."^{13,14} The incorporation of these principles is illustrated by the following case presentation.

CASE ILLUSTRATION

This woman (Fig 5, A) sought orthodontic consultation for "an improved smile." She had normal skeletal relationships, and the 2 major negative aspects of her smile were incomplete incisor display on smile (characteristic of an aging smile) and a flat smile arc (Fig 5, B). Her occlusal relationships were also normal, but her anterior tooth shape was disproportionate. Her maxillary incisors were somewhat square-looking and not as attractive as they could be. Specifically:

- 1 The central incisors were disproportionate in height to width. The maxillary right central incisor had a 1:1 height/width ratio, whereas the left central incisor's ratio was 9:10 (Fig 5, C).
- 2 The connectors were not ideal, with the connector lengths between the central incisors only 20%, between the central and lateral incisors 50%, and between the lateral incisors and the canines 50%. Gingival heights were also vertically disparate (Fig 5, D).
- 3 A tooth size discrepancy existed, with slight overjet due to maxillary excess.
- 4 The gingival shape was not elliptical, and the zeniths were located inappropriately.
- 5 The incisal embrasures were very small between the central incisors and too large between the central and lateral incisors.

To improve her smile and increase its youthfulness, incisor extrusion was needed to increase incisor display. It was possible for laminate veneers to deal with the tooth proportionality problem, but not all patients will approve of laminates, and they are not indicated in children. Because of the tooth size discrepancy, we believed tooth reshaping to be the best method to improve the appearance of her teeth. The decision to

narrow the teeth to attain more desirable tooth proportionality was based on 2 factors: (1) the maxillary tooth-size discrepancy with resulting overjet permitted retraction of the teeth against the mandibular incisors, and (2) the contacts and connectors would also benefit from alteration. An imaging session helped both the clinician and the patient to visualize the extrusion of the maxillary anterior teeth and its improvement on the smile arc and tooth display (Fig 5, E).

When orthodontic treatment was begun, the maxillary incisor brackets were placed more superiorly than the posterior brackets, so that the maxillary incisors were extruded. Once leveling was achieved, a thin bur was used to reduce the mesiodistal width of the incisors and appropriately lengthen the connectors where needed (Fig 5, F). When the spaces between the teeth were closed, the embrasure contours were finalized with a diamond-shaped bur. After reshaping the tooth proportions and relationships, the gingival shape and contour of the anterior teeth were assessed. The maxillary right central incisor was longer than the left, but the incisal edges were even. The zenith of the right central incisor was located too distally, whereas the left central incisor zenith was located to the mesial aspect of the tooth (Fig 5, G). With a soft tissue laser, the right central incisor was lengthened, and the soft tissue contouring was guided to move the zenith more to the mesial, but not on the center line of the tooth. The gingival shape on the left central incisor was contoured so that the zenith was moved from the mesial of the incisor to the point just distal to the center line of the tooth (Fig 5, H). After a brief healing period (48 hours), orthodontic appliances were removed, and the final tooth proportions and gingival contours were much more esthetically improved.

The final smile is shown in Figure 5, I, with improved tooth display and smile arc. The intraoral image (Fig 5, J) demonstrates improved tooth proportionality and gingival architecture. This case illustrates the incorporation of cosmetic dental principles into orthodontics to achieve superior dental and smile esthetic outcomes.

CONCLUSIONS

It is a common procedure for an orthodontist to reshape incisal edges to obtain better esthetic anterior dental contours. I have explored the possibilities for orthodontists to further refine the appearance of the anterior teeth to a degree that is not often pursued. I have also provided general guidelines for the clinician to follow in enameloplasty of the anterior teeth for more esthetic contours in finishing and refinement of the orthodontic outcome. By incorporating cosmetic dental think-

ing, it is not unreasonable for orthodontists to also consider tooth shape and proportionality as part of treatment planning and goal setting. In addition, I have discussed gingival contouring as part of orthodontic finishing. We will follow next with a series of articles on the use of soft tissue lasers in orthodontic practice.

REFERENCES

1. Lombardi RE. A method for classification of errors in dental esthetics. *J Prosthet Dent* 1974;32:501-13.
2. Levin EL. Dental esthetics and golden proportion. *J Prosthet Dent* 1978;40:244-52.
3. Richer P. *Artistic anatomy*. New York: Watson-Guption; 1971.
4. Gurel G. *The science and art of porcelain laminate veneers*. New Malden, Surrey, United Kingdom: Quintessence; 2003.
5. Gillen RJ, Schwartz RS, Hilton TJ, Evans DB. An analysis of selective tooth proportions. *Int J Prosthodont* 1994;7:410-7.
6. Shillingburg HT Jr, Kaplan MJ, Grace CS. Tooth dimensions. A comparative study. *J South Calif Dent Assoc* 1972;40:830.
7. Woelfel JB. *Dental anatomy: its relevance to dentistry*. 4th ed. Philadelphia: Lea and Febiger; 1990.
8. Moorrees CFA, Thomsen SO, Jensen E, Yen PKJ. Mesiodistal crown diameters of the deciduous and permanent teeth in individuals. *J Dent Res* 1957;36:39.
9. Mavroskoufis F, Ritchie GM. Variation in size and form between left and right maxillary central teeth. *J Prosthet Dent* 1980;43:254.
10. Morley J. A multidisiplinary approach to complex aesthetic restoration with diagnostic planning. *Prac Periodontics Aesthet Dent* 2000;12:575-7.
11. Morley J, Eubank J. Macroesthetic elements of smile design. *J Am Dent Assoc* 2001;132:39-45.
12. American Academy of Cosmetic Dentistry. *Diagnosis and treatment evaluation in cosmetic dentistry—a guide to accreditation criteria*. Madison: American Academy of Cosmetic Dentistry.
13. Gurel G. *The science and art of porcelain laminate veneers..* London: Quintessence; 2003.
14. Rufenacht CR. *Fundamentals of esthetics*. Chicago: Quintessence; 1990.