Simplified Smile Design: Everyday Predictability — Part I

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SYNOPSIS

Practitioners are increasingly using lasers for aesthetic soft and hard tissue crown lengthening. This article is divided into two parts: Part I, below, discusses the fundamentals of planning for the improved smile; and Part II, in the next issue of the Journal, will describe how lasers are used in the process.

INTRODUCTION

A beautiful smile has long been thought to be central to social and emotional passions. From Helen of Troy, the face that launched a thousand ships, to film stars like Julia Roberts and George Clooney, smiles have captivated audiences, influenced opinions, and sealed the first impressions for many. Recent emphasis on aesthetics and health by the current patient population has given rise to an accelerated growth in our understanding as to what makes up the perfect smile. Many attempts have been made to organize certain characteristics into checklist or digitized form in order to offer techniques that are teachable to dentists who are more scientist than artist.1-3 The author has coined the term Simplified Smile Design (SSD) which is a technique that allows the dentist to create a healthy, attractive smile that is harmonious with the face and pleasing to the patient. In this approach, the practitioner makes value judgments based on natural averages and overall patient appearance. SSD means (1) the smile fits the face, (2) the teeth fit the smile, and (3) the gingival drape presents the teeth in their most flattering manner. Dividing the analysis and treatment planning into these three areas and considering how they interplay biologically and functionally with each other greatly simplifies this complex task. There are many areas where lasers are very effective tools in achieving the health and natural aesthetic criteria demanded by the current generation of patients while maintaining periodontal stability.

SMILE DESIGN

In an ideal smile, few if any of the mandibular teeth are displayed, although they help to provide lip support, mentioned below. The maxillary central incisors are the boldest, brightest, and most dominant teeth. The size and shape of the central incisors are a function of space available, shape of the face, width of the arch, and position of the upper lip in both forced smile and repose. The lip/incisal edge position at rest varies by gender and age. A 20-year-old female may show 3 to 5 mm of tooth at rest (Figures 1A and B), while her male counterpart would show 1 to 2 mm less. A 50-year-old male will seldom show any tooth structure (Figures 2A and B), while his female counterpart may show a slight amount. This is due to sag of the facial drape from decreased

Figure 1A: View of a resting smile of a 17-year-old female

Figure 1B: View of a full smile of the patient shown in Figure 1A

Figure 2A: View of a resting smile of a 50-year-old male

Figure 2B: View of a full smile of the patient shown in Figure 2A
muscle tone and incisal wear of the teeth over time. Ideally, in a forced smile, no more than 1 to 2 mm of gingival tissues will be displayed.

It should also be noted that the positioning of the incisal edge of the teeth plays a significant role in the position and posture of the lips. When viewed in profile position, an imaginary line from the tip of the nose to the chin gives reference to evaluate the amount of protrusion of the teeth. This line is usually termed the Rickett’s Esthetic line (or E-line). The lower lip is dominant as it is influenced by and indicates the position of both the upper and lower incisors. On the average, on a patient with Class I occlusion, the lower lip should fall 3 mm behind this line (Figure 3). The size relation of the lips to each other can also be influenced by the positioning of the incisor teeth. The concept of the “golden proportion” can be applied, with the vertical dimension of the upper lip measured at the stomion (the median point of the oral slit when the oral cavity is closed) being 0.618 that of the lower lip. The term “golden proportion” is derived from Euclid, an ancient Greek mathematician, who described an ‘ideal’ ratio of a larger to a smaller object as 1.618 to 1, or, conversely, the smaller to the larger ratio as 0.618, with an infinite number of decimal places. A retroclined or even overly vertical tooth position can flatten the smile and decrease the size appearance of the upper lip. The desired position of the incisal edge can be determined by using these criteria for each patient as a unique individual.

Next, there has to be a strategy for determining a level occlusal and incisal plane relative to the patient’s functional presentation. With the relaxed patient standing upright and facing straight ahead, an imaginary line connecting each porion (the central point of the upper margin of the external auditory meatus) should be level with the horizon. The interpupillary line will often cant as will the maxilla, and neither should be used as a basis for determining the ideal incisal plane. Use of the horizon as a reference gives a never-changing standard for comparison. The use of face-bows, horizontal indicators, Fox plane plates, and anatomical indices has been advocated for establishing the occlusal plane. The Panadent face-bow (Panadent Corporation, Colton, Calif.) can be used by stationing the slotted jig and Fox plane parallel to the horizon in both the anterior-posterior and left-to-right directions, while the midline of the maxilla matches the midline of the jig and the leading edge of the horizontal orientation plane is perpendicular to the direction of gaze (Figures 4A and B). The plane established by the incisal edges of the maxillary central incisors should be parallel to the horizon. The midline embrasure is most appropriately placed in the middle of the maxilla, and it is critical that it be perpendicular to the incisal plane and therefore the horizon. The midline proximal embrasure has to be absolutely vertical to the horizon. Lip posture and incisal edge position (and how they complement the face) are the first of the three parts of SSD.

Figure 5 shows a smile meeting all criteria of Simplified Smile Design. A study by Kokich et al. showed that slight discrepancies in areas such as tooth length and width,
After orthodontic treatment or with tooth preparation, there is a limited amount of adjustment that can be made by moving the teeth labially, but this is limited by the lip position and posture. In essence, when the available width is determined, the frontals of the teeth can be adjusted upperly or inferiorly to follow the basic contour of the lower lip. This will produce a raised “gull” shape which should follow the general contour of the lower lip.

Overall, the shape of the lateral incisor is the most variant and individualizes the smile. Some degree of bilateral variation in size or position of the lateral incisor is a normally occurring event. In fact, many believe this adds character to the smile and adds a degree of individuality. The apparent width of the canine can be affected by the labial/palatal position of the tooth as well as rotation and cusp tip placement. Rotating the height of contour toward the midline produces a wider appearance and more dominance. The shape of the cusp tip can remain pointed or be displayed as blunt or rounded, according to the personal preference of the patient.

The shape of the teeth and placement of the contact area protect and preserve the periodontium. Normally, the incisal embrasures open or get deeper and wider as they move distally from the midline. This is a function of the position of the contact area. As the contacts migrate gingivally, the incisal embrasures open up (Figure 8). The contact area between the central incisors normally is in the incisal third, nearly at the incisal edge. This produces a narrow, short embrasure. Between the centrals

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Figure 6: View showing two “ideal” ratios of the maxillary teeth. The right central has an ideal width-to-length proportion 0.75 to 0.80. The relationship of the left incisors and cuspids follows the golden proportion from this frontal view. In other words, the left central is 1.61 times the width of the lateral, and the cuspid is 0.61 times the width of the lateral embrasures were not necessarily perceived as unesthetic by both trained and untrained observers. The author’s clinical experience has taught him that some of the above factors can be adjusted orthodontically or with tooth preparation. However, practitioners should be aware of overzealous treatment planning to alter what might not be perceived by the patient as an aesthetic concern.

All measurements and determination of tooth size and display should be made with the gingival drape in a healthy, uninflamed condition. The width of the central incisor is thought by some authors to fall in a range of 75 to 80 percent of its length (Figure 6). Some will even extend this range to as much as 86 percent, giving a broader appearance than is generally desired by the American population. In the absence of diastemas there is limited adjustment that can be made to the width of the teeth. Transfer of width and change of the appearance or perceived width is possible but in actuality there is a limited amount of adjustment that can be made. For example, some width can be gained by moving the teeth labially, but this is limited by the lip position and posture. In essence, when the available width is determined, the

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Figure 7: View of increasing axial inclination from the central incisor to the cuspid

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The teeth should angle slightly toward the midline and the incisal edges should be offset vertically to follow the basic contour of the lower lip. This angle increases slightly in the next posterior tooth (Figure 7). Simply put, the incisal edges form an upward smile rather than a reverse-contour frown. The incisal edge of lateral incisors can be in-line with those of the centrals or slightly offset to the gingival. This will produce a raised “gull” shape which also should follow the general contour of the lower lip.

As in the science of complete denture prosthesis, the remaining dentition is set up by the position of the maxillary centrals. The perceived width of each tooth moving distally along the arch follows the golden proportion, when viewed from the frontal aspect. Only the perceived width of the tooth is considered in this calculation, not the true measurable width. Thus each tooth in succession should be 61% of the perceived width of the tooth to its mesial (Figure 6). To achieve this “Golden Proportion,” adjustments in emergence profile and line angle/height of contour can be made. Premolars and at least the mesiobuccal cusp of the first molars should extend buccally, being positioned so as to be visible when viewed from the frontal aspect. This will fill the buccal corridor, leaving minimal or preferably no areas of void in the buccal corridor. Such areas are often described as ‘black triangles.’

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Figure 8: View of the placement of the contact area placement (horizontal line) and embrasure width of the teeth, as indicated by the ‘V’ shapes. Note that the contact area ‘moves’ gingivally and the embrasure widens relative to the adjacent mesial tooth.

and laterals the contact is typically at the incisal third junction which opens and deepens the embrasure. The embrasure between the lateral and the canine is normally closer to the midpoint vertical of the clinical crown, while the distal embrasure is placed at the midpoint. The incisal embrasures of the canines have distinct shapes. The mesial embrasure is in two planes and encompasses the mesial third of the incisal edge. The distal embrasure is longer and deeper and is a more flowing continuous curve. The size, shape, and position of the teeth are the second consideration in SSD.

When positioning the gingival drape apically, it is important for the practitioner to take into consideration the concept of biologic width or attachment width, sometimes referred to as the dentogingival junction. The biologic width consists of the sum of three components: the sulcular depth, the junctional epithelial attachment, and the connective tissue attachment. Gargiulo’s study in 1961 produced an average figure of 2.73 mm for biologic width in a healthy dentogingival junction, while the distal embrasure is placed at the midpoint. The incisal embrasures of the canines have distinct shapes. The mesial embrasure is in two planes and encompasses the mesial third of the incisal edge. The distal embrasure is longer and deeper and is a more flowing continuous curve. The size, shape, and position of the teeth are the second consideration in SSD.

Figure 9 provides an illustration of this concept and shows his average measurements for each component of the biologic width. A healthy periodontal attachment without inflammation or recession can be predictably maintained by avoiding any margin placement that would impinge on this attachment zone. More than 30 years later, Vasek et al. obtained somewhat higher average results with their histomorphometric analysis of cadaver jaws. Their mean measurements were 1.34 +/-0.84 mm for sulcus depth; 1.14 +/-0.49 mm for epithelial attachment; and 0.77 +/-0.32 mm for connective tissue attachment. There is quite a bit of variation from least to greatest attachment width. It has been determined that there is an individual biologic width for patients that will be consistent throughout a given area of the mouth. The individual attachment width can be determined by measuring the depth of the sulcus on a healthy adjacent or contralateral tooth, sounding the bone level, and subtracting the sulcus depth from the total gingival margin-to-bone measurement. The placement of any restoration margin must not impinge on this attachment width plus 50% of the width of the desired sulcus. Adherence to these guidelines will help ensure a predictable, healthy result.

It is also necessary to determine the extent of the soft tissue col and papilla when designing a smile. The gingival embrasure is a function of the size of the tooth root and the emergence profile. If the contact areas are angled more toward the incisal edge and the interproximal bone level is low, the possibility of an open embrasure or visualized black triangle exists (Figure 10). This possibility is predictably ascertained by sounding the bone level interproximally with an endodontic file. If the bone-to-contact-area distance is less than 5 mm and the tooth is properly contoured, the papilla will fill the space. If the distance is more than 6 mm, there is increasing likelihood of the papilla failing to fill the space. During tooth restoration, this can be addressed by extending the contact areas gingivally and palatally, leaving the facial line angles at a position that expresses a proper tooth shape and contour. Some degree of coloration may be applied to the palatalized interproximal tooth structure to enhance this effect.

The contour of the gingival scallop is also important and is a function of the emergence profile, the cementoenamel junction, and the facial contour of the tooth. The location of the gingival margin has been discussed and can be variable by design. The gingival drape should be displayed as a thin, pink mat between the picture of the teeth and the frame of the lips. More than 2 mm of gingival display in full smile is excessive and tends to be perceived as a gummy smile. A line connecting the soft tissue zenith of the canines should be parallel to the horizon and be at
the level of the zenith of the soft tissue scallop of the central incisors. The zenith of the centrals should be at the distal third of the tooth (Figure 11). The lateral can display some variation but should have its gingival zenith at the midpoint or slightly to the distal of the midpoint. The zenith of the canine should be at the distal third. Ensuring an optimal amount of gingival display, a level gingival plane, and healthy complete papillae presents the teeth in their most flattering manner. This fulfills the third concept of SSD. This is the area where we can most effectively use dental lasers, as shaping the gingival scallop and soft tissue col are procedures that are accomplished effectively with the use of dental lasers. This topic will be addressed in Part II of this article.

AUTHOR BIOGRAPHY
Dr. Charles Hoopingarner attended the University of Texas Health Science Center at Houston (UTHSCH) Dental Branch, graduating with a DDS in 1973. He has maintained a private practice in Houston, Texas since 1973. He was an adjunct associate professor in anatomical sciences at UTHSCH Dental Branch for 11 years. Currently he is adjunct clinical faculty in the Restorative Dentistry Department at UTHSCH and has been a clinical instructor at the Las Vegas Institute for Advanced Dental Studies since 1997, teaching advanced anterior aesthetics and comprehensive aesthetic reconstruction and laser dentistry. Dr. Hoopingarner is a member of the Board of Directors of the Academy of Laser Dentistry (ALD) and has used dental lasers of various wavelengths as integral parts of his patient care delivery system for the last 10 years. He holds Advanced and Standard Proficiency certifications in the Er:YAG wavelength from the ALD and has lectured internationally on the safety and use of laser technology in the dental practice. He may be contacted by e-mail at choop@swbell.net.

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REFERENCES