The Role of the Posed Smile in Overall Facial Esthetics

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ABSTRACT

Objective: To evaluate the role of the posed smile in overall facial esthetics, as determined by laypersons and orthodontists.

Materials and Methods: Twenty orthodontists and 20 lay evaluators were asked to perform six Q-sorts on different photographs of 48 white female subjects. The six Q-sorts consisted of three different photographs for each of two time points (pre- and posttreatment), as follows: (1) smile-only, (2) face without the smile, and (3) face with the smile. The evaluators determined a split-line for attractive and unattractive images at the end of each Q-sort. The proportions of attractive patients were compared across Q-sorts using a Wilcoxon signed-rank test for paired data. The evaluators also ranked nine facial/dental characteristics at the completion of the six Q-sorts.

Results: Evaluators found the pretreatment face without the smile to be significantly more attractive than the face with the smile or the smile-only photographs. Dissimilar results were seen posttreatment; there was not a significant difference between the three posttreatment photographs. The two panels agreed on the proportion of "attractive" subjects but differed on the attractiveness level of each individual subject.

Conclusions: The presence of a malocclusion has a negative impact on facial attractiveness. Orthodontic correction of a malocclusion affects overall facial esthetics positively. Laypeople and orthodontists agree on what is attractive. Overall facial harmony is the most important characteristic used in deciding facial attractiveness. (*Angle Orthod* 2010;80:322–328.)

KEY WORDS: Esthetics; Facial attractiveness; Q-sort; Facial characteristics; Orthodontist; Layperson

INTRODUCTION

Esthetic concerns about the smile often are the patient's main reason for seeking dental care.[1] The achievement of these esthetic goals presents many challenges, including occasional differing opinions between patients and clinicians as to what constitutes an esthetic smile.[2]

As part of standard orthodontic records, photographs are obtained in order to document the details of the hard and soft tissues. Three of the most frequently taken photographs are the profile photo, the frontal photo with the lips together, and the frontal smiling photo. The facial photographs are effective in providing a valid way of analyzing facial attractiveness.[3] The posed smile is used routinely when evaluating facial esthetics and smile characteristics because the posed smile is reproducible and can be generated on command.[4,5]

Several studies have examined the effects of various dental features on facial attractiveness using full-face photographs.[1,6–9] However, Shaw and colleagues[1] noted that the "background facial attractiveness … is often more assertive than the individual dental condition." This observation implies that the overall facial appearance of the patient may be more important than the smile region. It also has been

shown that facial esthetics are not dependent on any isolated facial characteristic.[9]

With regard to the method of analysis, a useful tool to examine pre- and posttreatment posed smile and overall facial esthetics is the Q-sort, which is a forced ordinal method that requires evaluators to rank objects on a scale of zero to eight.[10] This scheme has been shown to be a more reliable method, when compared to the visual analog scale, in terms of evaluating the smile and overall facial esthetics.[11]

The aim of the present study was to evaluate the importance of the posed smile and the role of orthodontic treatment on overall facial attractiveness. More specifically, the goals of this study were (1) to describe the role that the posed smile plays on overall facial esthetics, as determined by laypersons and orthodontists; (2) to describe the role of orthodontics in improving the posed smile with regard to overall facial esthetics; and (3) to investigate the most influential characteristics involved in rating facial attractiveness.

MATERIALS AND METHODS

Selecting the Sample

The original sample consisted of 139 randomly selected photographic records of female patients who were treated at the University of Michigan Graduate Orthodontic Clinic in Ann Arbor, Mich. Each subject signed a consent form granting us permission to use their photographs. The primary inclusion criteria were as follows:

- Female patients of white descent who had erupted permanent canines at T1 (beginning of treatment) and who completed orthodontic treatment (T2) while between 13.0 and 17.6 years of age;
- Pretreatment and posttreatment posed smile photographs with patient's eyes open and a natural-looking posed smile; and
- Absence of obvious facial characteristics or style features that would distract the evaluators and skew the results (ie, facial scars, large birthmarks, unusual hair or make-up).

Based on the inclusion criteria, a sample of 80 female patients was derived from the original sample of 139 patients. To reduce the sample further, as required by the Q-sort methodology,[10] 48 out of the 80 patients were selected randomly to participate in the six Q-sorts.

Selecting the Evaluators

The evaluators for this study were organized into two panels. The first panel consisted of 20 laypersons from the general public who were not current or recent patients or parents of orthodontic patients. None of them had received any dental education. The average age of the panel was 44 years, with participant ages ranging from 22 to 73 years.

The second panel consisted of 20 full- or part-time orthodontic faculty from the University of Michigan Graduate Orthodontic Program who were licensed to practice at the University of Michigan and/or in private practice. The average age for participants on this panel was 51 years, with ages ranging from 32 to 68 years. The average number of years participants had been in practice was 21.

Photography

Photographs were taken by the dental photography department using methods similar to those used in a previous study.[11] The 35-mm slides were taken as part of a routine series of pretreatment and posttreatment orthodontic records. For the current study, only the frontal posed smile photo was used.

The slides were scanned by way of a Nikon® Super Coolscan 4000ED (Nikon, Tokyo, Japan) slide scanner at high resolution and were stored as TIFF files. Each patient was randomly assigned a three-digit number. This number was used to identify the scanned image files in the computer and to label the back of the photographs used by the evaluators.

Photo Editing

Each facial photo was modified using Adobe® Photoshop® 7.0 (Adobe, San Jose, Calif) to standardize the background color (white) as well as the color and lighting of the face. The final edited photographs were saved as uncompressed TIFF files. The edited photographs then were used to create three different types of images for each of the 48 patients, pre- and posttreatment.

The first image (labeled the "smile-only" image) was a cropped image of only the teeth and lips (Figure 1). The photographs were cropped in a standardized way using a 3 × 5–inch grid.[11] The image remaining inside the grid was used as the smile photo for the study and was saved as a TIFF file.

The second image (labeled the "face without the smile" image) was created by cropping the full face with posed smile into 4 × 6–inch proportions and standardizing each photo so that the head size would be the same in all photographs. From each of these cropped images, the smile region was hidden by a 3 × 5–inch gray box (same proportions as the first image) (Figure 2).

Finally, the third image (labeled the "face with the smile" image) was created by cropping the full face
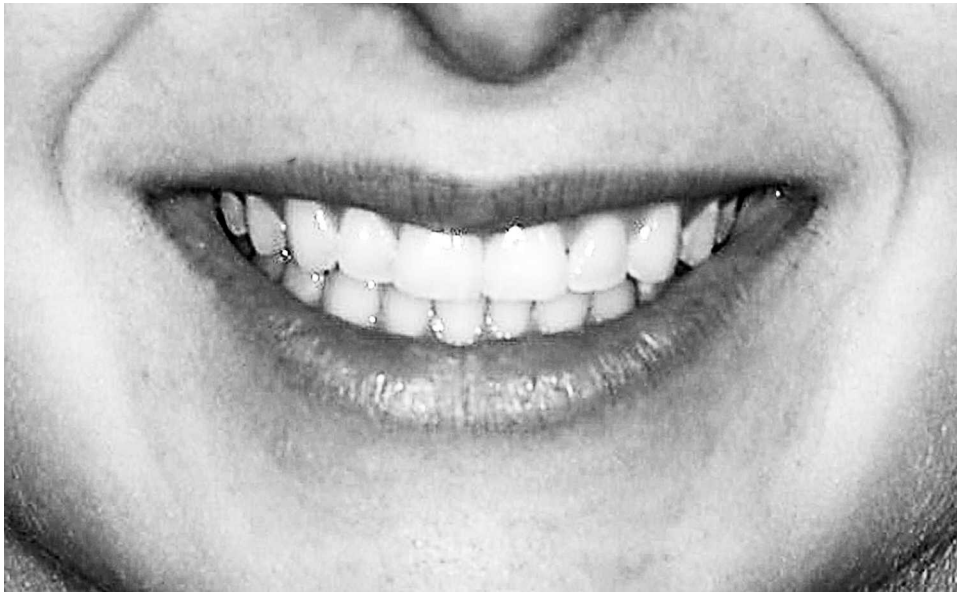
Figure 1. Smile-only photograph created by using a 3 × 5–inch grid.[11]

with posed smile in 4 × 6–inch proportions, standard-izing each photo so that the head size would be the same in all photographs (Figure 3).

After editing, all of the images were printed on 4 × 6–inch sheets of HP® Photo Paper using a HP® Photosmart D7260 printer (Hewlett-Packard Compa-ny, Palo Alto, Calif). The 3 × 5–inch images of the lips and teeth were centered in landscape format on the 4 × 6–inch pieces of photo paper. The images of the full face, with and without the gray box covering the smile region, were printed in portrait format to fill the 4 × 6–inch photo paper.

Figure 2. Face without the smile region visible. The smile region is blocked by a gray box.

Figure 3. Face with the smile region visible.

Q-Sort Protocol

The evaluators were asked to perform the Q-sorts in the following order, according to previously established methods: [11]

- Pretreatment smile-only,
- Posttreatment face without the smile,
- Posttreatment smile-only,
- Pretreatment face without the smile,
- Posttreatment face with the smile, and
- Pretreatment face with the smile.

The Q-sorts were performed in this order to decrease the chance that the evaluator would remember the ranking order of previous Q-sorts. At the completion of *each* of the six Q-sorts, before the photographs were collected, each evaluator was asked to make a split-line between "attractive" and "unattractive," and the split-line was recorded. After *all* of the six Q-sorts were completed, the evaluator then was asked to "Please rank the following characteristics from 1 to 9 (1 – not important, 9 – most important, using each number only once) based on how much each characteristic influenced your decision in the previous six tasks." The nine characteristics were amount of gingiva displayed, color of the teeth, eyes, hairstyle or color, lips, overall harmony of the face, quality of skin, shape of the teeth, and tooth alignment.

Statistical Analysis

The statistics for this study were computed using statistical software (version 15.0, SPSS, Chicago, Ill). The attractiveness for each patient was determined within each Q-sort by comparing the patient's Q-sort score to the split-line for that Q-sort for each rater. If the score was higher than the split-line, then the patient was given an attractive rating (scored as 1) for that Q-sort for that rater, and if the score was below the split-line, the patient was given an unattractive rating (scored as 0). Attractiveness ratings then were aggregated for each rater to derive the proportion of patients deemed attractive by a given rater within a given Q-sort.

The proportion of attractive scores for each evaluator was calculated by summing the number of attractive scores and dividing them by 48. The distributions, for both the orthodontic and lay panels, were evaluated for normality. There was a bimodal distribution of the proportions, and normality was violated for each of the Q-sorts. Therefore, nonparametric tests were used when comparing the proportions of attractive patients.

The proportions of attractive patients were compared across Q-sorts using a Wilcoxon signed-rank test for paired data. This analysis was preformed

separately for laypeople and orthodontists. A total of nine different comparisons were made (pretreatment smile-only vs pretreatment face without the smile, pretreatment smile-only vs pretreatment face with the smile, pretreatment smile-only vs posttreatment smile-only, pretreatment face without the smile vs pretreatment face with the smile, pretreatment face without the smile vs posttreatment face without the smile, pretreatment face with the smile vs posttreatment face with the smile, posttreatment smile-only vs posttreatment face without the smile, posttreatment smile-only vs posttreatment face with the smile, posttreatment face without the smile vs posttreatment face with the smile). An overall alpha of .05 with a Bonferroni correction was used for multiple comparisons, resulting in an alpha for each of the nine comparisons of 0.0055.

To compare the difference between lay and orthodontic evaluators in terms of proportion of "attractive" for each of the six Q-sorts, a Mann-Whitney *U*-test for independent samples was used. To evaluate the degree of within-patient agreement by multiple raters on the Q-sort score, intraclass correlations (ICCs, both individual and average) were calculated. A value of 1 indicates perfect agreement among the raters, while a value of 0 indicates only chance agreement. This value was calculated for both orthodontist and lay evaluators.

To analyze the rank of each facial characteristic (ie, quantity of gingiva, tooth color, eyes, hair, lips, overall harmony, skin, tooth shape, and tooth alignment), a nonparametric Friedman test was used. The mean rank assigned by the lay and orthodontic evaluators was used to assign an ordering to the relative importance of each characteristic. Kendall's coefficient of concordance was calculated to evaluate the degree of concordance on the rating within the orthodontic and lay evaluators. A Mann-Whitney *U*-test was used to compare the ranking of each characteristic between orthodontists and laypeople.

RESULTS

Average Split-Line for the Q-Sorts

The average split-lines for each Q-sort for both lay and orthodontic evaluators are listed in Table 1. The comparisons on the proportions of "attractive" images in the Q-sort performed for lay and orthodontic evaluators are reported in Tables 2 and 3, respectively. There were no statistically significant differences between the lay and orthodontic evaluators for any of the Q-sorts (Table 4). The ICCs were used to examine the interrater reliability. Single-measure ICCs showed fair to good interrater agreement (0.474 for laypeople, 0.501 for orthodontists); the scores can be considered

Table 1. Average Split-Lines for Orthodontist and Lay Evaluators

	Average Split-Line	
Q-Sort	Orthodontist	Lay
Pretreatment smile only	4.56	4.70
Pretreatment face without smile	2.60	3.05
Pretreatment face with smile	4.15	3.75
Posttreatment smile only	2.75	3.30
Posttreatment face without smile	3.00	3.60
Posttreatment face with smile	3.05	3.15

excellent when the average-measure ICCs (0.947 for laypeople, 0.953 for orthodontists) are considered.

Ranking of Facial Characteristics

The rankings of the facial characteristics are reported in Table 5. No statistically significant difference was found for the rank order between the lay and orthodontic evaluators. Overall facial harmony and tooth alignment were most important to both evaluator panels; skin and hair were least important (Table 6). For lay evaluators, the Kendall's coefficient of concordance was 0.195, a low concordance. For the

orthodontist panel, it was 0.497, indicating fair concordance.

DISCUSSION

The Role of the Posed Smile

The primary objective of this study was to examine the role of the posed smile in overall facial esthetics. As a secondary objective, this study examined the differences between the orthodontic and lay evaluators to determine which characteristics influenced the evaluators from both groups in making their decisions.

With respect to the primary objective, the results show that the posed smile has considerable impact on facial esthetics, especially before treatment. Other studies[1,9,12] have reported that the overall facial attractiveness is more important than the dental attractiveness. Although this observation may be true, this study proves that the smile region is important to the esthetics of the face. More specifically, it demonstrates that an unattractive smile can have a negative influence on overall facial attractiveness. In the pretreatment Q-sorts for both panels, the face without

Table 2. Comparison of Proportion of Patients Found to Be Attractive for Lay Evaluators from a Nonparametric Wilcoxon Signed-Rank Test[a]

		Significance Level	
Q-Sort Comparison—Lay	More Attractive	Not Corrected	With Bonferroni
Pre-tx smile only vs pre-tx face w/o smile	Pre-tx face w/o smile	0.001*	**
Pre-tx smile only vs pre-tx face w/ smile	Pre-tx face w/ smile	0.018*	NS
Pre-tx smile only vs post-tx smile only	Post-tx smile only	0.003*	**
Pre-tx face w/o smile vs pre-tx face w/ smile	Pre-tx face w/o smile	0.119	NS
Pre-tx face w/o smile vs post-tx face w/o smile	Pre-tx face w/o smile	0.181	NS
Pre-tx face w/ smile vs post-tx face w/ smile	Post-tx face w/ smile	0.027*	NS
Post-tx smile only vs post-tx face w/o smile	Post-tx smile only	0.413	NS
Post-tx smile only vs post-tx face w/ smile	Post-tx face w/ smile	0.343	NS
Post-tx face w/o smile vs post-tx face w/ smile	Post-tx face w/ smile	0.121	NS

[a] Pre-tx indicates pretreatment; w/o, without; w/, with; NS, not significant; and post-tx, posttreatment.
* $P < .05$.
** $P < .0055$.

Table 3. Comparison of Proportion of Patients Found to Be Attractive for Orthodontist Evaluators from a Nonparametric Wilcoxon Signed-Rank Test[a]

		Significance Level	
Q-Sort Comparison—Orthodontist	More Attractive	Not Corrected	With Bonferroni
Pre-tx smile only vs pre-tx face w/o smile	Pre-tx face w/o smile	0.001*	**
Pre-tx smile only vs pre-tx face w/ smile	Pre-tx face w/ smile	0.165	NS
Pre-tx smile only vs post-tx smile only	Post-tx smile only	0.000*	**
Pre-tx face w/o smile vs pre-tx face w/ smile	Pre-tx face w/o smile	0.002*	**
Pre-tx face w/o smile vs post-tx face w/o smile	Pre-tx face w/o smile	0.044*	NS
Pre-tx face w/ smile vs post-tx face w/ smile	Post-tx face w/ smile	0.002*	**
Post-tx smile only vs post-tx face w/o smile	Post-tx smile only	0.302	NS
Post-tx smile only vs post-tx face w/ smile	Post-tx smile only	0.287	NS
Post-tx face w/o smile vs post-tx face w/ smile	About equal	0.805	NS

[a] Pre-tx indicates pretreatment; w/o, without; w/, with; NS, not significant; and post-tx, posttreatment.
* $P < .05$.
** $P < .0055$.

Table 4. Mann-Whitney *U*-Test Comparing the Proportion Attractive for Lay vs Orthodontic Evaluators

Q-Sort	*P* Value	Significance[a]
Pretreatment smile only	.904	NS
Pretreatment face without smile	.327	NS
Pretreatment face with smile	.314	NS
Posttreatment smile only	.265	NS
Posttreatment face without smile	.265	NS
Posttreatment face with smile	.718	NS

[a] NS indicates not significant.

Table 6. Rank Order of Facial Characteristics Based on Friedman Mean Ranks

Layperson Rank Order	Orthodontist Rank Order
Overall harmony	Overall harmony
Tooth alignment	Tooth alignment
Tooth shape	Quantity of gingiva
Eyes	Eyes
Quantity of gingiva	Lips
Tooth color	Tooth shape
Lips	Tooth color
Hair	Skin
Skin	Hair

the smile was rated as being significantly more attractive than the pretreatment face with the smile or the smile alone. The evaluators viewed the face without the smile as more attractive, because the unattractive smile region was not visible in the photo. When the smile region was revealed, both orthodontists and lay evaluators found the face to be less attractive with the smile. In accordance with these observations, the pretreatment face with the smile was rated as more attractive than the pretreatment smile alone, since the unattractive smile region was camouflaged partially by the overall face.

This same discrepancy was not seen in the posttreatment photographs, however, indicating that by correcting the malocclusion and improving the smile region, the smile is more in harmony with overall facial esthetics. Although others believe that orthodontics may not directly render a person more attractive,[9] this study demonstrated that by improving smile esthetics, the overall face will be perceived as more attractive.

After the malocclusion is corrected orthodontically, the posttreatment smile-only photographs become more attractive. The results show that the posttreatment smile-only is more attractive than the pretreatment smile-only for both panels. Similarly, when the smile region is more esthetic, it is more in harmony with the overall facial esthetics. The attractive posttreatment lips and teeth create less of a discrepancy between the smile-only, face with the smile, and face without the smile.

The posttreatment face with the smile was more attractive than the pretreatment face with the smile. As stated previously, the correction of the malocclusion affected the overall facial esthetics positively. The attractive posttreatment smile region caused the posttreatment photographs to be judged as more attractive than the pretreatment photographs.

Comparison of Orthodontic and Lay Evaluators

A substantial agreement between dental professionals and laypersons has been demonstrated in many other studies testing facial and smile characteristics.[11,13–16] The current study confirms that orthodontists and laypersons are in agreement when it comes to evaluating facial esthetics. The results show that there was not a significant difference between the two panels when determining the proportion of attractive subjects for each of the six Q-sorts. The lay and orthodontic panels also agreed on the ranking of the facial characteristics.

Reliability of the Orthodontic and Lay Evaluators

Examination of the ICCs, both average and individual, revealed that the interrater reliability was within the boundaries of acceptability.[11,17] These results are similar to those of Schabel and colleagues,[11] showing fair to good reliability for the single-measure ICC and excellent average-measure ICC reliability. The individ-

Table 5. Single Measure and Average Measure Intraclass Correlation (ICC) for Orthodontic and Lay Evaluators

Characteristics	Orthodontist Mean Rank	Layperson Mean Rank	*P* Value	Significance[a]
Overall harmony	7.70	6.85	.314	NS
Tooth alignment	7.20	6.45	.314	NS
Quantity of gingiva	6.25	4.90	.060	NS
Eyes	5.45	5.35	.968	NS
Lips	5.40	4.00	.051	NS
Tooth shape	4.85	5.85	.157	NS
Tooth color	3.00	4.40	.060	NS
Skin	2.60	3.45	.149	NS
Hair	2.55	3.75	.183	NS

[a] NS indicates not significant.

ual ICC was fair to good (laypersons 0.474, orthodontist 0.501), demonstrating that if individual raters were asked to perform the same task under similar conditions again, there would be a good to fair comparison between current responses and the future responses. The average ICC was excellent (laypersons 0.947, orthodontist 0.953), demonstrating that if a group of raters was asked to perform the same task under similar conditions again, similar results would be found.

Ranking of Facial Characteristics

Although no single characteristic determines facial attractiveness,[9] it is important to attempt to elucidate the hierarchy of facial characteristics. In order to gain insight into exactly what was influencing the decisions by the evaluators, the judges were asked to rank nine different characteristics in order of importance. The two panels did not show statistical differences with respect to the ranking of the facial characteristics. The two most important characteristics were overall facial harmony and tooth alignment. The two least important characteristics were the skin and hair (which had been controlled for, in part). Even though dental professionals and the lay public may not always agree on the attractiveness of a smile,[2] they agree on the importance of each facial characteristic when rating a smile.

The degree of concordance on the rating within the orthodontic and lay evaluators was fair and low, respectively. The higher degree of concordance among the orthodontic panel may have been due to the extra training that they received, which presumably created a bias toward similar characteristics.[16]

CONCLUSIONS

- Before orthodontic treatment, the presence of a malocclusion can have a negative impact on facial attractiveness.
- After orthodontic treatment, a corrected malocclusion will be more in harmony with overall facial attractiveness.
- Orthodontist and lay evaluators generally agree on the appraisal of attractive subjects.

- Orthodontist and lay evaluators agree on the importance of each facial characteristic, with overall facial features as the most relevant esthetic feature.

REFERENCES

1. Shaw WC, Rees G, Dawe M, Charles CR. The influence of dentofacial appearance on the social attractiveness of young adults. *Am J Orthod*. 1985;87:21–26.
2. Jornung J, Fardal O. Perceptions of patients' smiles: a comparison of patients' and dentists' opinions. *J Am Dent Assoc*. 2007;138:1544–1553.
3. Howells DJ, Shaw WC. The validity and reliability of ratings of dental and facial attractiveness for epidemiologic use. *Am J Orthod*. 1985;88:402–408.
4. Ackerman JL, Ackerman MB, Brensinger CM, Landis JR. A morphometric analysis of the posed smile. *Clin Orthod Res*. 1998;1:2–11.
5. Rigsbee OH III, Sperry TP, BeGole EA. The influence of facial animation on smile characteristics. *Int J Adult Orthod Orthognath Surg*. 1988;3:233–239.
6. Mackley RJ. An evaluation of smiles before and after orthodontic treatment. *Angle Orthod*. 1993;63:183–189.
7. Moore T, Southard KA, Casko JS, Qian F, Southard TE. Buccal corridors and smile esthetics. *Am J Orthod Dentofacial Orthop*. 2005;127:208–213.
8. Isiksal E, Hazar S, Akyalcin S. Smile esthetics: perception and comparison of treated and untreated smiles. *Am J Orthod Dentofacial Orthop*. 2006;129:8–16.
9. Tatarunaite E, Playle R, Hood K, Shaw W, Richmond S. Facial attractiveness: a longitudinal study. *Am J Orthod Dentofacial Orthop*. 2005;127:676–682.
10. Stevenson W. *The Study of Behavior*. Chicago, Ill: University of Chicago Press; 1953.
11. Schabel BJ, McNamara JA Jr, Franchi L, Baccetti T. Q-Sort assessment vs. visual analog scale in the evaluation of smile esthetics. *Am J Orthod Dentofacial Orthop*. 2009;135: S61–71.
12. Shaw WC. The influence of children's dentofacial appearance on their social attractiveness as judged by peers and lay adults. *Am J Orthod*. 1981;79:399–415.
13. Brisman AS. Esthetics: a comparison of dentists' and patients' concepts. *J Am Dent Assoc*. 1980;100:345–352.
14. Dunn WJ, Murchison DF, Broome JC. Esthetics: patients' perceptions of dental attractiveness. *J Prosthodont*. 1996;5: 166–171.
15. Peck H, Peck S. A concept of facial esthetics. *Angle Orthod*. 1970;40:284–318.
16. Roden-Johnson D, Gallerano R, English J. The effects of buccal corridor spaces and arch form on smile esthetics. *Am J Orthod Dentofacial Orthop*. 2005;127:343–350.
17. Fleiss J. *The Design and Analysis of Clinical Experiments*. New York, NY: John Wiley and Sons; 1986.