

Original Article

Smile line and occlusion: An epidemiological study

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ABSTRACT

Background: The purpose of the present study was to discuss some new concepts of the desirable characteristics of smile tooth display. Due to the increasing application of cosmetic dental treatments, there is an increasing need for better understanding of the esthetic principles.

Materials and Methods: In the present descriptive study, with 212 participants, included were patients with no history of orthodontic treatment, loss or prosthetic replacement of anterior teeth, extracted teeth, lips with asymmetry or a history of trauma. Chi-square test was used to determine possible significances in the relation of smile line to Angle occlusion class, overbite and overjet and arch form. A *P* level of <0.05 was set as to be significant.

Results: Chi-square test indicated that there was a significant difference between the smile design and overbite, overjet and gender but no statistically significant association was found between the smile design and crossbite, molar Angle classification and arch form.

Conclusion: Within the limitations of such studies, it might be concluded that there is a significant and important relation between some occlusal parameters and smile design, which must be considered.

Key Words: Dental esthetics, occlusion, overbite, overjet, smile line

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INTRODUCTION

The effect of attractive smile on positive self-image^[1] has been discussed to be even more than that of the physical attractiveness stereotype.^[2] Many investigators have therefore tried to find out the secret behind the impact of a beautiful smile.^[3] The concept of smile line was first discussed by Frush and Fisher in 1985^[4] and revisited by Jameson^[5] in 2002. They defined the smile line as “the harmony between the curvature of the incisal edges of the maxillary anterior teeth and the upper border of the lower lip.” Hulsey highlighted the importance of the congruency of the curvatures of the upper border of the lower lip and

the incisal edge of the maxillary incisor to obtain an attractive smile.^[6] Tjan *et al.*^[7] described an “average smile” as one that exhibits the full clinical crown of the six maxillary anterior teeth and also the premolars from frontal view. They also mentioned that in an average smile the incisal curve of the maxillary teeth should be parallel to the inner curvature of the lower lip.

Several aspects of smile esthetics and its influencing factors have been already discussed. These include the effect of vertical dimension and factors like gender on smile height,^[8] the display of teeth upon spontaneous and posed smiling according to the position of the lip line,^[9] photographic analysis of the smile,^[10] the characteristics of the smile in a population of normally looking people,^[11] etc.

Authors have suggested diagnostic implications of reduced lip-line height, tooth display, and smile width while posed smiling, in a more reliable estimation of lip-line height, smile arc, buccal corridors, and plane of occlusion. Dynamic video recording of spontaneous

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smile have been proposed to the more advantageous in this regard than the posed smile recordings.^[9] Furthermore, authors have proposed methods to visualize ideal smile specifically for each individual based on the literature. Smile line, dental midline, tooth display, negative spaces, dental proportions, and symmetry stand are among the most important criterion discussed.^[10] Also, the maximum smile line position has been proposed as the most reproducible and comparable quantitative reference for clinical decision making in esthetic restoration of the smile anatomy.^[11] Although these assessments clearly show the tendency towards better understanding of the smile and its related factors, dental profession has nonetheless not achieved sufficient evidence for clinical setting application. One of the shortcomings of the smile literature is lack of evidence regarding the association of occlusal factors, including but not limited to Angle molar classification, presence of anterior or posterior cross bite, overjet and overbite, etc, with the smile line. The present study was aimed to assess the effect of occlusal parameters on smile line.

MATERIALS AND METHODS

Included were 212 volunteers, 20-30 years old, from the patients and students of the School of Dental Medicine of Azad University of Tehran, without a history of orthodontic treatments, missing teeth, extracted teeth, prosthetically replaced teeth, intruded or extruded anterior teeth, anterior teeth with wear, traumatized lips, and asymmetrical lips. Demographic data were also recorded for all the patients.

Study setting

A digital camera was used to take photos of the patients with natural teeth with complete smile. This was accomplished by asking the patient to pronounce the letter Z (zee). The photos were taken from the inferior one-third of the volunteers' face with head straight at rest so that the line passing the angle of the lips will be parallel to the horizon. The photos were then restored into a desktop computer and the type of smile line was determined and recorded in the data sheets.

- To determine the arch type, alginate impressions were taken from the patients' maxillary arches, poured into dental stone casts, and recorded upon examination.
- Occlusal Angle classification was determined based on intraoral examination of the position of the mandibular first molar relative to the maxillary first molar and recorded.

- To determine the overbite, the labial surface of the lower central incisors were marked at the resting level of the incisal edge of the upper central incisors using a pencil while maximum intercuspation. The distance between the incisal edge of the lower lateral incisors and the marked line was measured in millimeters.
- To determine the overjet, the distance between the labial surface of the lower central incisors to that of the upper central incisors was measured using a ruler in millimeters while maximum intercuspation.

Statistics

Chi-square test was used to determine possible significances. A *P* level of <0.05 was set as to be significant.

RESULTS

Tables 1 through 6 summarize the smile line types of the volunteers in the present study, respectively, according to genders, Angle molar classification of occlusion, overbite, overjet, arch form, and the presence of crossbite. Subjects mostly showed parallel smile line and class I occlusion [Figure 1].

In this study, although chi-square test did not show any statistically significant differences between the different Angle occlusion classes in terms of the smile line (*P* = 466), class II subjects were nonetheless more

Table 1: The frequency of the smile line types according to the genders

	Parallel	Straight	Reverse	Total
♀	107 (79.3%)	23 (17%)	5 (3.7%)	135
♂	46 (59.7%)	22 (28.6%)	9 (11.7%)	77
Total	153	45	14	212

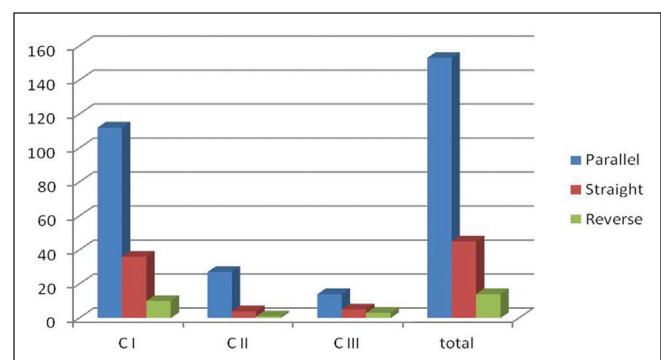


Figure 1: The comparative illustration of the frequency of the smile line types according to the Angle molar classification of occlusion where divisions of Class II are not considered

Table 2: The frequency of the smile line types according to the Angle molar classification of occlusion

	Parallel	Straight	Reverse	Total
C I	112 (70.9%)	36 (22.8%)	10 (6.3%)	158
C II D I	13 (81.3%)	3 (18.7%)	0	16
C II D II	14 (87.6%)	1 (6.2)	1 (6.2)	16
C III	14 (63.6%)	5 (22.8%)	3 (13.6%)	22
Total	153	45	14	212

Table 3: The frequency of the smile line types according to overbite (OB)

	Parallel	Straight	Reverse	Total
Open	4	0	0	4
OB=0	10	5	5	20
OB<3 mm	33	23	7	63
3≤OB≤5	86	16	2	104
OB>5 mm	20	1	0	21
Total	153	45	14	212

Table 4: The frequency of the smile line types according to overjet (OJ)

	Parallel	Straight	Reverse	Total
OJ<0 mm	2	0	1	3
0≤OJ<1	8	3	4	15
1≤OJ≤3	103	35	9	147
OJ>3 mm	40	7	0	47
Total	143	45	14	212

Table 5: The frequency of the smile line types according to arch form

	Parallel	Straight	Reverse	Total
Ovoid	108	39	9	156
Square	31	5	3	39
Tapering	14	1	2	17
Total	153	45	14	212

Table 6: The frequency of the smile line types according to the presence of posterior crossbite (CB)

	Parallel	Straight	Reverse	Total
CB	17	6	4	27
No CB	136	39	10	185
Total	153	45	14	212

frequently associated with a parallel smile line (70.9% versus 81.2%, respectively). Straight smile was almost equally found in the C I I and C I III subjects (22.8% versus 22.7%, respectively). Reverse smile line was mostly noticed in C I III individuals (13.6%).

Chi-square showed a significant association between the smile line type and overbite ($P = 0.001$) [Table 3]. Deep bite subjects (95.2%) almost always had a parallel smile line. Also, a significant association was found between the smile line type and overjet ($P = 0.03$) [Table 4]. No statistically significant differences were noticed between the frequencies of smile line types in different arch types ($P = 0.209$) or in the presence or absence of posterior cross bite ($P = 0.17$).

DISCUSSION

In the present study, 72.2% of the study population had a parallel smile line. The straight and reverse smile lines were observed in 21.2% and 6.6% of the volunteers, respectively. Dong *et al.*^[3] reported these values to be 60%, 34%, and 5%, respectively. The difference between the frequency values of the two studies is most likely to be the result of the different age ranges used in the present study. While the present study included only 20-30 years old volunteers, the study of Dong *et al.* have not specified any age limit in its inclusion criteria. Parallel smile line tends to turn into straight and even reverse smile lines with age due to the reduced tonicity of the lip muscles and physiological wear of teeth.

In accordance to the standpoint of Dawson,^[12] no statistically significant association was found between the different smile line types and Angle occlusal classification. The authors of the present study then further confirm the concept that the beauty of smile is independent of the intermaxillary relation. Moreover, the highest frequency of parallel smile line was observed for the Class II Division II subjects. This is most likely attributable to the increased overbite in these subjects. On the other hand, the least frequency of the parallel smile line was observed in the Class III subjects, which is most probably due to the reduced overbite or marked wear resulting in alteration of the smile line from parallel to straight and even reversed. Class I Angle occlusion cases will be placed between these two groups.

Straight smile line was observed mostly in the Class I and Class III occlusions with somehow similar frequency. In Class II subjects, however, this frequency was much lower and this was regardless of the division classification. Moreover, reversed smile line was mostly associated with a Class III occlusion type which is not far from expectation. Class II

Division I subjects were associated with the least frequency of reversed smile line. Also, the frequency of parallel smile line was higher than other smile lines in all three occlusion types. The authors of the present study believe that in a Class III occlusion, smile line will most likely be affected due to the fact that the lower lip line will most likely not be in a proper position relative to the upper teeth. It may then be concluded that creating an ideal smile will not be realistic in a Class III patient. Nevertheless, a significantly improved smile might result from orthognathic surgeries.

According to the studies of Kerns *et al.*^[13] patients with severe skeletal deformities along with their malocclusion, might not achieve an ideal or even satisfactory smile upon completion of orthognathic interventions. A satisfactory or ideal smile will most likely be restored in patients with rather normal skeletal relations. Also, the results of the present study, although confirming those of the Owens *et al.*^[14,15] regarding to the incidence of Class I Angle occlusion, are nonetheless slightly different in terms of the incidence of Class II and III occlusions. While Owens *et al.* found that Class I occlusion has the highest frequency in their study of each of six racial groups, they reported the Class II occlusion to be the least frequent in all races. In our series of volunteers, however, Class III showed the least occlusion frequency.

In the present series of subjects, the highest and the lowest frequency of parallel smile line was observed in the deep bite and the edge to edge cases, respectively. Based on this pattern, the frequency of parallel smile line seemingly increases with overbite. Also, the frequency of straight smile line decreases with overbite. The highest frequency of straight smile line is then observed in minimum overbite namely edge to edge and light overbites. Moreover, the frequency of reversed smile line is in reverse relation to the overbite. Due to the small number of subjects in the openbite group, a valid generalization will not be logical.

Based on our findings, the frequency of parallel smile line increases with overbite. It can be concluded that arranging the artificial anterior teeth short of the proper position or any other discrepancy in the arrangement of these teeth may affect the smile line. Similarly, any worn incisal surface of the anterior teeth will most likely reduce overbite and adversely affect the beauty of smile. As mentioned before, although

increased overbite parallels the smile line, whether the mere increase of overbite will result in restoration of a parallel smile is nevertheless debatable. Further studies are needed to find the answer to the question.

Along with the smile line, anterior guidance is of paramount importance in restoring anterior teeth, which is influenced by overbite. According to our findings, parallel smile line is mostly associated with ovoid arch types while it is least seen in the tapering arch shape. This phenomenon is believed to be attributable to the fact that the ovoid arch shape is more likely to be associated with superior positioning of the teeth axes compared to the tapering arch shape.

Although the differences did not turn out to be statistically significant, crossbite was mostly and least associated with the reversed and the parallel smile lines, respectively. It would have been definitely more accurate to prepare and mount dental diagnostic casts. The high number of participants did not allow the authors to follow this method. Rather, each case was examined by two individuals independently. To the best of our knowledge, the present study is the first to have concerned the probable relationship of the smile line and occlusal parameters. The present study is the first of a series of investigations on the same topic and we eagerly look forward to co-operate with interested institutions worldwide.

CONCLUSION

Within the limitations of the present study, a significant and important relation between occlusal parameters and smile design is suggested. Further in-depth studies are mandatory.

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