

# Perceptions of orthodontically treated smile esthetics: a comparative evaluation of orthodontists, general dentists, and laypersons in Erbil city

Isra Dilshad Rostum<sup>(1)</sup>; Zana Qadir Omer<sup>(2)</sup>

**Background and Objective:** Knowing the perception of a layperson will help an orthodontist to have an idea about acceptable smile in our community. The study is aimed to evaluate and compare the smile perception among orthodontists, general dentists, and laypersons in a sample of Erbil city.

**Method:** Groups of variations made on an orthodontically treated smile picture. The ideal smile picture was purposefully altered to produce thirty-two more images with eight common anterior esthetic discrepancies in varying degrees of deviation. Crown length, Crown width, Incisor crown angulation, Midline, Open gingival embrasure, Buccal corridor, Occlusal plane, and Gingiva to lip distance. A close-ended questionnaire is prepared. In this study, 235 individuals from three groups of varying educational levels served as evaluators: general dentists, orthodontists, and laypersons.

**Results:** There is significant difference in perception between groups. The orthodontists were more sensitive than the other two groups. Laypersons could only detect variations in crown length, width and angulation. General dentists were second most perceptive except for gingiva to lip distance and buccal corridor. One-way ANOVA is used for statistical analysis and the Post Hoc LSD test is used for significant ANOVA.

**Conclusion:** The result of this study showed that there was significant difference among the three groups of evaluators. Laypersons have a higher threshold level of acceptance than dentists and orthodontists. The most sensitive in detecting variations were orthodontists followed by General dentists.

**Key words:** Smile, Smile Perception, Dental esthetic, Orthodontics, Mini-esthetics.

---

<sup>(1)</sup>Department of POP, College of Dentistry, Tishk University, Erbil, Iraq.

<sup>(2)</sup>Department of POP, College of Dentistry, Hawler Medical University, Erbil, Iraq.

Correspondent Name: -Isra Dilshad Rostum

Email:isra.dilshad@yahoo.com

## Introduction

Dento-facial aesthetics plays an essential part in modern dental practice, as the impact of social media is increasing so that patients seeking esthetics.<sup>1</sup> Facial composition as a component of a person's physical beauty is an essential social problem in cultures since it is the determining factor in personality assessments, performance, and interpersonal success in contexts such as school and workplace.<sup>2, 3</sup> Langlois, Kalakanis<sup>4</sup> concluded that attractive children and adults obtain more favourable academic and performance evaluations than unattractive people. According to reports, the face is the most influ-

ential feature in determining the aesthetic perception of a person, and during interpersonal interactions, the eyes and mouth receive the most attention.<sup>5</sup> Havens, McNamara<sup>6</sup>, revealed that dental alignment is a more essential feature than the eyes when judging facial beauty. An important treatment objective is to create an appealing, well-balanced smile.

A smile is one of the most significant facial expressions, as well as a nonverbal criterion of communication, that conveys happiness, friendliness, and appreciation.<sup>7</sup> Recently, dental esthetics has become a primary concern for patients and dentists, as well as a component in the physical health of individ-

uals.<sup>8</sup> The aesthetics of a smile were reported to be the major reason patients sought cosmetic and orthodontic treatment.<sup>9-11</sup>

Kiyak<sup>3</sup> investigated the effect of orthodontic treatment on patients' quality of life and found that patients seeking orthodontic and esthetic treatment are more concerned with improving their appearance and social acceptability than their dental function or general health. These psychological effects were constant across investigations of participants of different nationalities.<sup>12-14</sup> This concept has been further subdivided into macro-, mini-, and micro-esthetics due to the rapid development of the field following the discovery of esthetics' vital role.<sup>15</sup>

Despite the enormous amount of effort invested in defining the standards for facial esthetics, there have been no clear criteria for relating to a layperson's perception. The goal of this study is to investigate, via the use of digitally modified photographs, the impact of different variations on the perception of smile aesthetics as rated by orthodontists, general dentists, and laypersons. With this method, the integration of smile esthetics with orthodontic treatment can be improved to satisfy the expectations of the patient. There is no prior research conducted in the city of Erbil about the perceptions of laypersons, dentists, and orthodontists regarding orthodontic treatment outcomes.

## METHODS

This comparative study took place in different governmental and private dental clinics, Salahadin University college of science and art, Hawler Medical University and Tishk university in Erbil city.

**Three groups of different professions were included in this study:** orthodontists, general dentists, and laypersons. The orthodontists and general dentists consisted of graduates of both Hawler Medical University and Tishk university college of Dentistry. The orthodontists who have registered in Erbil branch of Kurdistan Dental Association are included in the study. The layperson consisted of Lecturers from Salahadin University college of art and science.

### **Exclusion criteria:**

Laypersons who have knowledge about oral esthetics, or golden proportion, or any education in sciences associated with the study

of the face or art. The general dentists who had an orthodontic course.

A convenience sampling technique was used in this study. Each rater was given as little information about the study as possible. A total of 310 questionnaires were distributed to the 3 groups. The number of respondents were 8 of 15 for the orthodontists, 74 of 95 for the laypeople, and 153 of 200 for the general dentists. That means 120.67% of total estimated response rate, the following table shows the frequency of response for different educational level (Table 1).

### Photo standardization and manipulation

The image is that of an orthodontically treated female, exhibiting a posed smile with intact permanent dentition and no obvious facial or dental defects. The images were obtained from the archive of a private dental clinic (Noor Dent Center).

The image selected for this research was a frontal view of the anterior teeth, gingival tissues, and lips (figure 1). The nose and chin were removed from the images to limit the number of confounding elements that may influence the perception of the smile. Distractions, such as facial blemishes or facial hair, were minimized.

The ideal smile picture was purposefully altered to produce thirty-two more images with eight common anterior esthetic discrepancies in varying degrees of deviation. The eight deviations were selected following consultation with clinically experienced orthodontists and general dentists. Deviations were chosen based on their frequency of occurrence and clinical significance to the smile. Editing and manipulating of images were done by using (Adobe Photoshop CC 2022). Each esthetic characteristic was altered in varying increments. Some were altered in 0.5-mm increments, some in 1.0-mm, and others in 2.0-mm increments. The degrees of deviation from the ideal smile chosen in this study were based on acceptable amounts of deviation proposed by other similar studies.<sup>16, 17</sup>

**Table 1:** Table shows frequency of response rate for each evaluator group.

	Estimated respondents	Respondent	Response rate
Orthodontists	6	8	133.30%
General Dentists	177	153	86.40%
Laypersons	52	74	142.30%
Average	235	235	120.67%

**Figure 1:** Original Picture

The ideal smile photograph was altered based on the following variables:

#### 1. Crown Length

The maxillary central incisors were selected for modification, and constant reference sites for these measures were the most superior points along on the labial gingiva margin. The crown length was reduced in increments of 0.5 mm by reducing the level of the marginal gingiva (Figure 2).

#### 2. Crown Width

Since the most frequent variation in crown width influences the width of the lateral incisors, the maxillary lateral incisors were altered in terms of crown width. We obtained measurements between the interproximal contact points. The level of the marginal gingiva was maintained, and the width of the lateral incisor crowns was reduced by 1.0-mm increments (Figure 3).

#### 3. Incisor Crown Angulation

The maxillary incisor crowns were tilted toward the patient's right side in increments of 5°. A reference point was a line drawn

from the midline papilla to the most gingival portion of the incisal embrasure between the maxillary central incisor crowns (Figure 4).

#### 4. Midline

The whole maxillary dental segment was moved in increments of 1.0 millimeters to the patient's left. The "cupid's bow," which is located in the center of the upper lip, was used to indicate the facial midline (Figure 5).

#### 5. Open Gingival Embrasure

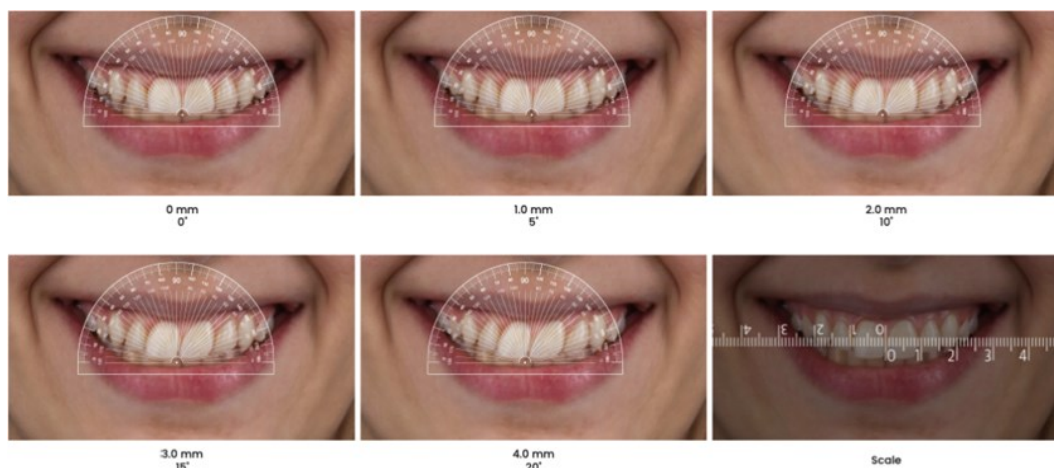
The gingival embrasure between central incisors is modified by relocating the interproximal contact point gingivally in increments of 1.0 mm. The length of the open gingival embrasure was measured from the tip of the interdental papilla to the point where it made contact with the interproximal area of the tooth (Figure 6).



**Figure 2:** Crown length of maxillary central incisors was shortened in 0.5-mm increments.



**Figure 3:** Crown width of maxillary lateral incisors was decreased in 1.0-mm increments.



**Figure 4:** Maxillary incisor crowns were angled to the patient's right in 5° increments.

## 6. Buccal corridor

The measurement of the buccal corridor was calculated as the percentage of the width between the inner lip commissures. Four different buccal corridors were created: wide (0% buccal corridor), medium-wide (10% buccal corridor), medium-narrow (20% buccal corridor), and narrow (30% buccal corridor) (Figure 7).

## 7. Occlusal Plane

The occlusal plane of the maxilla changed by revolving around a center point at the incisal embrasure between the central incisor crowns, each alteration varied in 2° increments. The segment was rotated inferiorly on the left and superiorly on the right of the subject (clockwise) (Figure 8).

## 8. Gingiva-to-Lip Distance

The smile was modified by gradually repositioning the upper lip superiorly and inferiorly to alter the distance between the lip and the gingival margin. The labial gingival margins of the maxillary central incisors served as reference points. The upper lip was positioned at this level, marked as 0 mm. Additional lip positions were 2-mm inferior to this level and 2, 4, and 6-mm superior to it (Figure 9).

## Questionnaire

A self-administered, close-ended, questionnaire was prepared. The questionnaire comprised seven printed pages that included the edited colored smile photographs. The questionnaire consisted of two parts: The first part is demographic data (age, gender, profession, and years of experience). The second part of the questionnaire was composed of images and a rating scale. The images were arranged in a random sequence to reduce confounders. The participants were asked to score the attractiveness of each smile image separately using a rating scale from 1-5 (non-attractive=1, slightly attractive=2, acceptable=3, attractive=4, and very attractive=5).

## Statistical analysis

Data were handled and analyzed using the statistical package for social sciences (SPSS) software, Version 28. Descriptive data were obtained through frequencies. The study involved the use of one-way ANOVA to analyze the perception of dental and pharmacy students toward the ideal smile. LSD post hoc test for significant ANOVA results.

## Crown Length

Laypersons were less discerning of a crown length discrepancy than the two dental groups. On average, a 2-mm deviation from the ideal crown length was required for the layperson to classify it as slightly attractive ( $p < 0.000$  general dentists,  $p < 0.009$  orthodontists). Orthodontists identified a 1-mm discrepancy from ideal as less attractive ( $p < 0.836$  general dentists,  $p < 0.025$  laypersons).

## Crown Width.

Orthodontists needed a mesio-distal dimension 2 mm smaller than the ideal lateral incisor crown width before rating it as less attractive ( $p < 0.757$  general dentists,  $p < 0.008$  laypersons). General dentists and non-specialists noticed the change at 3-mm ( $p < 0.001$ ).



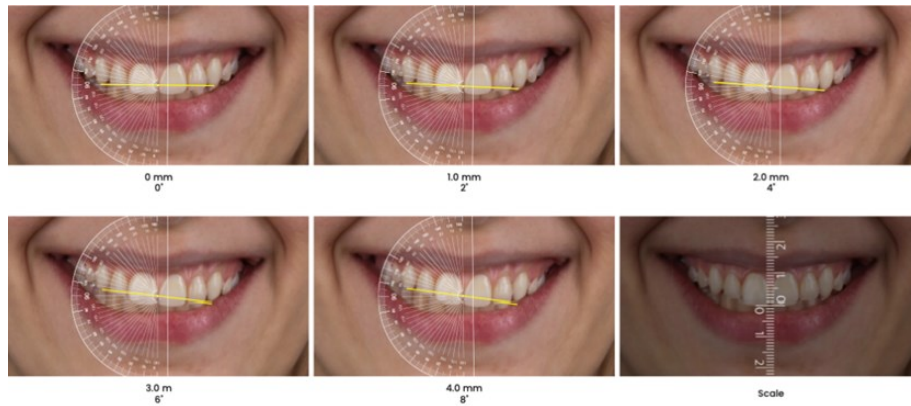
Figure 5: The dental midline shifted in 1.0-mm increments to the patient’s left.



Figure 6: The interproximal contact point between the maxillary central incisors was moved gingivally in 1.0-mm increments.



Figure 7: The width of buccal corridor was altered to 0%, 10%, 20%, and 30%.



**Figure 8** The occlusal plane altered in 2° increments in clockwise direction.



**Figure 9:** The distance from the upper lip to the gingival margin was altered in 2-mm increments.

## RESULT

The demographic data shows that females made up 57.4% (135) of the sample and men made up 42.6% (100) of the sample. The age range of the reviewers ranged from 21 to 56 years old, with 55.6% being younger than 26 (Table 2).

There is a very high significant difference between the three groups of evaluators (F-Test P- Value<0.001) (Table 3).

The threshold at which each group could accept between the ideal smile and deviations from the ideal varied (Table 4).

**Table 2:** Age and Gender Distribution according to educational level.

		Education Level					
		General Dentist		Orthodontist		Layperson	
		Count	Column N %	Count	Column N %	Count	Column N %
Age group	<26	85	55.6%	0	0.0%	0	0.0%
	26-30	47	30.7%	2	25.0%	3	4.1%
	>30	21	13.7%	6	75.0%	71	95.9%
Gender	Female	96	62.7%	3	37.5%	36	48.6%
	Male	57	37.3%	5	62.5%	38	51.4%

**Table 3:** ANOVA test for significance level between groups.

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	40.06060606	2	20.03030303	32.7768595	<b>1.4119E-11</b>	3.091191259
Within Groups	58.66666667	96	0.611111111			
Total	98.72727273	98				

**Table 4:** Threshold levels of significant difference.

	Orthodontists	General Dentists		Laypersons
Crown length (mm)	1	1.5		2
Crown width (mm)	2	3		3
Incisor crown angulation (°)	5°	10°		20°
Midline (mm)	3	4		ND
Open gingival embrasure (mm)	2	3		ND
Buccal corridor (%)	0	ND		ND
Occlusal plane (°)	4°	6°		ND
Gingiva to lip distance (mm)	6	ND		ND
ND= non-detectable				

### Crown Length

Laypersons were less discerning of a crown length discrepancy than the two dental groups. On average, a 2-mm deviation from the ideal crown length was required for the layperson to classify it as slightly attractive ( $p < 0.000$  general dentists,  $p < 0.009$  orthodontists). Orthodontists identified a 1-mm discrepancy from ideal as less attractive ( $p < 0.836$  general dentists,  $p < 0.025$  laypersons).

### Crown Width.

Orthodontists needed a mesio-distal dimension 2 mm smaller than the ideal lateral incisor crown width before rating it as less attractive ( $p < 0.757$  general dentists,  $p < 0.008$  laypersons). General dentists and non-specialists noticed the change at 3-mm ( $p < 0.001$ ).

### Incisor Crown Angulation

The 5° change from ideal incisor angulation for orthodontists was marked less attractive ( $p < 0.000$  laypersons,  $p < 0.204$  general dentists). Laypersons were least perceptive than other groups as they were able to identify the discrepancy at 20° ( $p < 0.000$  for orthodontists and general dentists).

### Midline

Orthodontists were able to identify a 3-mm variation in the maxillary dental midline from the ideal ( $p < 0.000$  laypersons,  $p < 0.519$  general dentists), while for general dentists at 4-mm ( $p < 0.000$  layperson,  $p < 0.211$  orthodontists). However, the laypersons did not perceive a significant difference in esthetics even with a 4-mm deviation ( $p < 0.000$ ).



### **Open Gingival Embrasure**

Orthodontists assessed a 2-mm open gingival embrasure as significantly less pleasant than an ideal smile with a normal gingival embrasure ( $p=0.002$  for layperson  $p=0.387$  for the general dentist). In contrast, it took a greater deviation of 3-mm for the general dentists to rate the smile as less attractive ( $p<0.000$  layperson,  $p<0.232$  general dentist). Laypersons were unable to detect the change ( $p<0.000$ ).

### **Buccal Corridor**

Wide smile (0% buccal corridor) was slightly attractive to the orthodontist ( $p<0.000$  laypersons,  $p<0.043$  general dentists) and all other deviations were acceptable. However, neither the general dentists nor lay people perceived a significant difference in esthetics even with a 30% narrow smile ( $p<0.014$ ).

### **Occlusal Plane**

Orthodontists could detect a  $4^\circ$  canting and it was significantly non-attractive ( $p<0.000$  laypersons,  $p<0.040$  general dentist) and general dentists could detect a  $6^\circ$  occlusal plane asymmetry slightly attractive ( $p<0.000$  layperson,  $p<0.069$  orthodontists). Laypersons were not able to detect an occlusal plane asymmetry at any level ( $p<0.000$ ).

### **Gingiva to Lip Distance**

None of the three groups discriminated between levels of maxillary gingival absence on smiling (upper lip position at 2-mm inferior to the gingival margin) ( $p>0.05$ ). However, all three groups distinguished between this level and an increasing distance from the gingiva to the lip. General dentists made the distinction between acceptable and slightly attractive when the distance was 6-mm ( $p<0.000$  layperson,  $p<0.505$  orthodontist).

### **DISCUSSION**

The study aimed to compare the perception of smile esthetics among orthodontists, general dentists, and laypersons in a sample of Erbil city. The result of the study showed that there is a very high significant difference among the orthodontists, general dentists and laypersons in evaluating the variations (F-Test, P-Value $<0.001$ ).

As described by Kokich Jr, Asuman Kiyak<sup>16</sup>, there is a threshold level that a digital

alteration must exceed for the viewer to detect the variation. This study demonstrates a difference in how dentists, orthodontists, and laypersons evaluate smiles. Here, orthodontists rated the smiles differently from laypersons and dentists, with the latter two groups being less sensitive to detect variations. This might be because most orthodontists have received more academic training on smile esthetics than laypersons and dentists. In general the threshold level for orthodontists was less and as the variation was more become less attractive to them this result coincides with a study done by Kokich Jr, Asuman Kiyak<sup>16</sup>. In this study, orthodontists found that a 1mm discrepancy in central incisor crown length was unattractive, while dentists and laypersons considered a smile ugly when the reduction in crown length was 1.5 and 2 mm respectively. This result is consistent with that of the previous research,<sup>16</sup> in which he found that the thresholds of ugly smiles were 1.0, 1.5 and 2.0 mm for orthodontists, general dentists and laypersons, respectively. The crown length must be greater than the crown width for upper incisors. Typically, the length-to-width ratio is 1:0.8,<sup>18</sup> requiring the incisors to be rectangular rather than square. For patients with short crowns, composite restorations, porcelain restorations, or gingivectomy may improve the problem.

Orthodontists were evaluated as being superior to two other groups in perceiving alteration in lateral incisor crown width. The threshold for orthodontists was 2mm while for general dentists and layperson was 3mm. This threshold differed from that reported by Kokich Jr, Asuman Kiyak<sup>16</sup>, in which 2 mm changes are required to be unesthetic for orthodontists. The crown width ratio (maxillary lateral incisor: maxillary central incisor) should be 0.618:1 (golden ratio) for an aesthetically pleasing smile.<sup>19,20</sup>

If the patient has lateral incisors in the form of a wedge, orthodontic treatment may be required to create sufficient space before making composite or porcelain restorations to attain the golden ratio.

A 2 mm open gingival embrasure represented the threshold of acceptability in orthodontists, whereas in general dentist, 3 mm was the limit of acceptability. Laypersons even with 4mm open gingival embrasure was acceptable to them. Consequently, changed papillary heights may not be an esthetic disadvantage when seen by the general public. These results indicated that the participants in our study were slightly less sensitive to black triangles compared with laypeople in the study of Kokich Jr, Asuman Kiyak<sup>16</sup>, who found that laypeople could detect a 3-mm open gingival embrasure.

The study results also showed that the minimum gingiva to lip distance in which orthodontists felt a smile ugly was 6 mm. General dentists and laypersons >6mm of the gingiva to lip distance was acceptable. Contrary to the findings of<sup>16</sup>, where the gingival exposure threshold for both general dentists and non-professionals to consider a smile unpleasant was 4 mm, our data indicates that the gingival exposure threshold for both general dentists and non-professionals to consider a smile unpleasant is much lower.

Our study also found that when the midline shift was  $\geq 3$ mm, orthodontists and general dentists rated it as slightly attractive. Laypersons did not rate the smile as poorly aesthetic. This result is consistent with the findings of the research reported by Kokich Jr, Asuman Kiyak<sup>16</sup>, in which laypersons failed to detect a 4 mm difference in the midline and, orthodontists were more perceived than both groups.

In addition, the results showed that when the occlusal plane was tilted 6°, the general dentists began to evaluate the smile as ugly. Meanwhile, the orthodontists perceived the smile as ugly at a 4° tilted occlusal plane. The laypersons did not find the occlusal plane canting as ugly even in 6°. This result is inconsistent with two other studies. Research by Ker, Chan<sup>21</sup> pointed out that the threshold for tilting the occlusal plane was 4° for laypersons,

while Silva, Jimenez-Castellanos<sup>22</sup> found that laypersons began to feel the smiles as poorly aesthetic at a 5° tilted occlusal plane. Padwa, Kaiser<sup>23</sup> reported that the perception of occlusal plane canting depends on the degree of inclination rather than the levels of experience of the observers.

The study reveals that there was no significant difference in evaluating buccal corridors, only 0% buccal corridor was less attractive to orthodontists. Some investigations have noted that buccal corridor spaces do not have a relationship to smile esthetics; this study supports these findings.<sup>24, 25</sup>

Other studies reported that buccal corridors have little impact on smile esthetics and will not influence the overall rating of a smile by orthodontists, general dentists, and laypersons.<sup>26-28</sup>

This study revealed that laypersons and general dentists perceive buccal corridor space with less discrimination than orthodontists. The results were consistent with the findings of Rajeev, Vinoth<sup>29</sup>, who concluded no variation in perception between general dentists and laypersons when assessing buccal corridor spaces. In contrast, narrow buccal corridors were shown to be more attractive in the Jordanian population.<sup>30</sup>

The result showed that 5° was detected by the orthodontist, while the general dentist could detect the variation at 10°. Laypersons accepted <20° incisor crown angulation. This study shows that there is a difference in perception of different educational levels which is in contrast with a study done by<sup>31</sup> Thomas, Hayes<sup>32</sup> analyzed the effect of various degrees of axial midline angulation on the attractiveness of a smile and found a significant difference between orthodontists and laypeople.

Our results show that orthodontists were more perceptive to variations in smiles than dentists, who were more perceptive than

laypeople. The study's limitations mainly lie in its small sample size. As the research relied on a questionnaire, additional objective assessments may corroborate the study's findings more concretely. As Sriphadungporn and Chamnannidiadha<sup>33</sup> found, perception varies with the age of evaluators as well. Additional research comparing the perceptions of many other ethnic groups and age groups, as well as the addition of images depicting variations in increments, is required.

### Conclusions

The orthodontists were most sensitive in detecting variations in this study. Laypersons have higher a threshold level of acceptance than dentists and orthodontists. Tooth color was ranked secondary after tooth irregularities among the three groups.

### Conflict of interest

The author reported no conflict of interests.

### References

- Baik KM, Anbar G, Alshaikh A, Banjar A. Effect of Social Media on Patient's Perception of Dental Aesthetics in Saudi Arabia. *International Journal of Dentistry*. 2022;2022:4794497.
- Bull R, Rumsey N. *The social psychology of facial appearance*: Springer Science & Business Media; 2012.
- Kiyak HA. Does orthodontic treatment affect patients' quality of life? *Journal of dental education*. 2008;72(8):886-94.
- Langlois JH, Kalakanis L, Rubenstein AJ, Larson A, Hallam M, Smoot M. Maxims or myths of beauty? A meta-analytic and theoretical review. *Psychological bulletin*. 2000;126(3):390.
- Batwa W, Hunt NP, Petrie A, Gill D. Effect of occlusal plane on smile attractiveness. *The Angle Orthodontist*. 2012;82(2):218-23.
- Havens DC, McNamara JA, Jr., Sigler LM, Baccetti T. The role of the posed smile in overall facial esthetics. *Angle Orthod*. 2010;80(2):322-8.
- Tjan AH, Miller GD, The JG. Some esthetic factors in a smile. *J Prosthet Dent*. 1984;51(1):24-8.
- Birkeland K, Bøe OE, Wisth PJ. Relationship between occlusion and satisfaction with dental appearance in orthodontically treated and untreated groups. A longitudinal study. *The European Journal of Orthodontics*. 2000;22(5):509-18.
- Moskowitz M, Nayyar A. Determinants of dental esthetics: a rationale for smile analysis and treatment. *Compendium of continuing education in dentistry (Jamesburg, NJ)*. 1995;16(12):1164, 6, passim; quiz 86-, 6, passim; quiz 86.
- Albino J, Tedesco L, Conny D. Patient perceptions of dental-facial esthetics: shared concerns in orthodontics and prosthodontics. *The Journal of prosthetic dentistry*. 1984;52(1):9-13.
- Proffit W, Fields Jr H, Sarver D. *Contemporary Orthodontics St Louis: Mosby Elsevier*; 2007. Proffit W *Contemporary Orthodontics St Louis: Mosby Elsevier*. 2007.
- Gupta T, Sadana G, Rai HK. Effect of esthetic defects in anterior teeth on the emotional and social well-being of children: a survey. *International journal of clinical pediatric dentistry*. 2019;12(3):229.
- Feldens CA, Senna RA, Vargas-Ferreira F, Braga VS, Feldens EG, Kramer PF. The effect of enamel fractures on oral health-related quality of life in adolescents. *Dental Traumatology*. 2020;36(3):247-52.
- Barbier L, Pottel L, De Ceulaer J, Lamoral P, Duyck J, Jacobs R, et al. Evaluation of quality of life after mandibular reconstruction using a novel fixed implant-supported dental prosthesis concept: a pilot study. *International Journal Of Prosthodontics*. 2019;32(2):162-73.
- Sarver DM. The importance of incisor positioning in the esthetic smile: the smile arc. *Am J Orthod Dentofacial Orthop*. 2001;120(2):98-111.
- Kokich Jr VO, Asuman Kiyak H, Shapiro PA. Comparing the perception of dentists and lay people to altered dental esthetics. *Journal of Esthetic and Restorative Dentistry*. 1999;11(6):311-24.
- Kokich VO, Kokich VG, Kiyak HA. Perceptions of dental professionals and laypersons to altered dental esthetics: asymmetric and symmetric situations. *American Journal of Orthodontics and Dentofacial Orthopedics*. 2006;130(2):141-51.
- Khan M, Khan MA, Hussain U. Clinical crown length, width and the width/length ratio in the maxillary anterior region in a sample of mardan population. *Pakistan Oral & Dental Journal*. 2015;35(4).
- Levin EI. Dental esthetics and the golden proportion. *The Journal of prosthetic dentistry*. 1978;40(3):244-52.
- Rufenacht CR. *Fundamentals of esthetics*: Quintessence Publishing (IL); 1990.
- Ker A, Chan R, Fields HW, Beck M, Rosenstiel S. Esthetics and smile characteristics from the layperson's perspective: a computer-based survey study. *The Journal of the American Dental Association*. 2008;139(10):1318-27.
- Silva BP, Jimenez-Castellanos E, Martinez-de-Fuentes R, Greenberg JR, Chu S. Laypersons' perception of facial and dental asymmetries. *International Journal of Periodontics & Restorative Dentistry*. 2013;33(6).
- Padwa BL, Kaiser MO, Kaban LB. Occlusal cant in

- the frontal plane as a reflection of facial asymmetry. *Journal of oral and maxillofacial surgery*. 1997;55(8):811-6.
24. Hulseley CM. An esthetic evaluation of lip-teeth relationships present in the smile. *Am J Orthod*. 1970;57(2):132-44.
25. Johnson DK, Smith RJ. Smile esthetics after orthodontic treatment with and without extraction of four first premolars. *American Journal of Orthodontics and Dentofacial Orthopedics*. 1995;108(2):162-7.
26. Moore T, Southard KA, Casco JS, Qian F, Southard TE. Buccal corridors and smile esthetics. *American Journal of Orthodontics and Dentofacial Orthopedics*. 2005;127(2):208-13.
27. Parekh SM, Fields HW, Beck M, Rosenstiel S. Attractiveness of variations in the smile arc and buccal corridor space as judged by orthodontists and laymen. *The Angle Orthodontist*. 2006;76(4):557-63.
28. Roden-Johnson D, Gallerano R, English J. The effects of buccal corridor spaces and arch form on smile esthetics. *American Journal of Orthodontics and Dentofacial Orthopedics*. 2005;127(3):343-50.
29. Rajeev AN, Vinoth S, Nagalakshmi S, Rajkumar B, Dhayanithi D, Kumar P. Evaluation of buccal corridor sizes in esthetic smile perception among general dentists and laypersons. *Journal of Indian Academy of Dental Specialist Researchers*; Volume. 2018;5(1).
30. Abu Alhaija ES, Al-Shamsi NO, Al-Khateeb S. Perceptions of Jordanian laypersons and dental professionals to altered smile aesthetics. *The European Journal of Orthodontics*. 2011;33(4):450-6.
31. Yang S, Guo Y, Yang X, Zhang F, Wang J, Qiu J, et al. Effect of mesiodistal angulation of the maxillary central incisors on esthetic perceptions of the smile in the frontal view. *American Journal of Orthodontics and Dentofacial Orthopedics*. 2015;148(3):396-404.
32. Thomas JL, Hayes C, Zawaideh S. The effect of axial midline angulation on dental esthetics. *The Angle Orthodontist*. 2003;73(4):359-64.
33. Sriphadungporn C, Chamnannidiadha N. Perception of smile esthetics by laypeople of different ages. *Progress in orthodontics*. 2017;18(1):1-8.