An Evaluation of Upper Lip Length and Thickness Changes on Smiling in Patients with Class I, Class II Div1, 2 of Malocclusion According to Angle's Classification

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Abstract

Background: The objective of this study was to evaluate upper lip length and thickness changes in the vertical dimensions at maximum smile in patients with class I and class II div 1,2 of malocclusion According To Angle's Classification.

Methods: Video equipment was used to capture video (5-10 second) for 120 randomly selected subjects. The subjects were divided into three groups by class of malocclusion According To Angle's Classification. Each group was further subdivided by gender (20 males, 20 females). Two frames for each subject were selected, one frame representing the lips at rest and the second representing the natural unstrained posed smile. The data for the subjects were analyzed by using 1-way analysis of variance (ANOVA) with the Bonferroni post-hoc test.

Results: Statistically significant differences were apparent in most of the measured variables. Changes in upper lip length and upper lip thickness were higher in class I followed by class II div2 then class II div1. The upper lip in the smile of patients with Class II division 1 was positioned downward, and the upward movement of the upper lip (changes in length and thickness) was smaller in comparison with the other groups.

Changes in upper lip length and upper lip thickness on smiling were greater in males as compared with females in all groups.

Conclusions: Data from this study clearly indicate that malocclusion effects on the changes in upper lip length and thickness on smiling, and the changes differ between males and females.

Keywords: Smile; Digital video; Malocclusion; Lip length; Lip thickness

Background

The most common reason for seeking orthodontic treatment is to improve dentofacial esthetics. It is now accepted that modern orthodontic treatment requires a shift away from Angle's paradigm of achieving ideal occlusion to the more esthetically focused soft tissue paradigm that is based on the patient's overall benefit [1,2].

According to Hulsey, "Smile is one of the most effective means by which people convey their emotions." [3] Majority of orthodontic literature and diagnosis is based on patient's profile and lips at rest while analyzing a static photograph and / or lateral cephalogram [4-17]. The reason that smiles had not been readily studied in the past could be due to the difficulty in capturing a reliable, repeatable smile [1,2,18]. Although these orientations provide an adequate amount of diagnostic information, they do not contain all of the information needed for smile visualization and quantification. The records needed for contemporary smile

visualization and quantification can be divided into 2 groups: static and dynamic. The dynamic recording of smile can be accomplished with digital Videography. Videography allows us to capture standardized/reproducible smile, thus minimizing the error when studying one snapshot. Digital video and computer technology enables the clinician to record anterior tooth display during speech and smiling at the equivalent of 30 frames per second. The videos are recorded in standardized fashion with the camera at a fixed distance from the subject [1, 2.]

The smile is a result of the interaction of various components that form the smile, and we need to understand the principles which are involved in creating a balance between the teeth and soft tissues [19].

Esthetic of smile depends on relationship between the teeth and lips and the way that lips and soft tissue frame the smile. A pleasant smile also depends on the quality and beauty of the dental elements and their harmonious integration. Dental components of the smile include the size, shape, color, alignment, and crown angulation (tip) of the teeth; the midline; and arch symmetry [20,21].

There are indications that there are differences in facial movements between the genders [22] Modern psychological research indicates that men and women possess different smile behavior [23].

This study is carried out to check malocclusion and gender related changes in upper lip length and thickness on smiling.

Materials and Methods

Participants

The present study was conducted on 120 subjects randomly selected from the students and staff of faculty of dentistry in Hama University. It was explained to the subjects that this was a study on lip movements involving a short questionnaire followed by a (5- 10 second) video clip capturing only a small part of the face (chin to nose). Video graphic records of these 120 subjects, who willingly consented to participate in the study, were taken to study the perioral zone at rest and on smiling.

The subjects were divided into three groups, namely, group 1 (class I), group 2 (class II div1), group 3 (class II div2), with each group containing 20 males and 20 females.

Inclusion criteria:

- Age range between 18 and 28 years.

- No active orthodontic treatment

Selection Criteria for the Class-II Sample

Class II div 1:

- Bilateral Class-II Buccal segments "molar and canine" with convex facial profile.

 (The skeletal classification was not considerable)

- Proclination of maxillary front teeth with an overjet of > 4 mm.

Class II div 2:

- Bilateral Class-II Buccal segments "molar and canine".

 (The skeletal classification was not considerable)

Exclusion criteria:

- Missing tooth visible on smiling

- Prosthodontics /Restorative work on tooth/ teeth visible on smiling

- Gross facial asymmetry

- Visible periodontal disease, caries, excessive dental attrition

- history of orthodontic treatment

- Lip irregularities, or history of lip surgery.

Smile Recording and Measurements

The subjects were explained that this was a study on smile involving a 5- to 10-second video clip of a small part of the face. An informed consent was obtained from each subject who agreed to participate in the study voluntarily.

A video camera (SONY DSC-H200) was set on the tripod 4 feet from the subject. The subjects were seated on the adjustable stool and instructed to hold the head in natural head position by looking straight into an imaginary mirror. If head position required correction, the researcher helped the subject into natural head orientation. The camera lens was adjusted to be parallel to the apparent occlusal plane and the camera focused only on the mouth (from nose to chin) so that the person could not be identified. Included in the capture area (frame) were 2 rulers with millimeter markings. The rulers were secured in a cross configuration so that if the subject accidentally rotated 1 ruler, the other could be used to analyze the frame. The relaxed lip position was achieved by asking the subject to lick the lips and then swallow. Then, the subjects were instructed to say ''Subject number __'' and then smile.

Recording began 1 second before the subject started speaking and ended after the smile.

The video clip was downloaded to a computer (**LG RD590**) and uploaded to ScenalyzerLive (version 4.0, Andreas Winter, Vienna, Austria), a video-editing software program. Each frame was analyzed, and 2 frames were captured for the study. Each frame was then analyzed, and finally two frames were selected for the study. The first frame represented the subjects' lips at rest or relaxed lip position, and the second frame represented the subjects' natural unstrained **posed smile**. The widest commissure-to commissure posed smile frame was selected as one of 10 or more frames showing an identical smile. Thus, the selected smile image represented a sustained and hence repeatable smile position.

Each frame was opened in Adobe Photoshop 6.0 (Adobe Systems, San Jose, Calif) and adjusted by using the millimeter ruler in the frame. Calibration of the software was done in accordance with the previous study of Desai et al [7].

Measurements on Rest Frame (Figure 1)

1. Upper lip length- from subnasale to stomion superius

2. Upper lip thickness- vertical distance from the most superior point of cupid's bow to the most inferior portion of the tubercle of the upper lip

Measurements on Smile Frame (Figure 2)

1. Upper lip length- subnasale to stomion superius

2. Upper lip thickness- vertical distance from the most superior point of cupid's bow to the most inferior portion of the tubercle of the upper lip

The measurements were made on rest and the posed smile photograph as shown in **Figures 1 and 2 and Table 1.**

Statistical Analysis

Minitab® 15 (Minitab Inc, State College, PA, USA) was used to perform the statistical analysis. With alpha set at 5%, Data were summarized as mean 6 SD. Groups were compared by two-factor (class of malocclusion and sex) analysis of variance (ANOVA) using general linear models. If the ANOVA showed statistical significance, the Bonferroni post hoc test was done to determine which groups were significant from the others.

Results

The results are shown in **Tables 2** through **7.**

At rest position, The Class I subjects possessed higher values of upper lip length followed by Class II div2 then Class II div1, this difference was significant ($P < .05$) between (Class I, II div1, 2) and non-significant between (class II div1, II div2).**(Table 3)**

At smile position, The Class II div2 subjects possessed higher values of upper lip length followed by Class II div1 then Class I, this difference was significant ($P < .05$) between (Class I, II div1, 2) and non-significant between (class II div1, II div2) **(Table 5).** The upper lip length was significantly higher in males compared with females in all groups at both rest and smile positions. **(Table 2, 4)**

The Class I subjects – at rest position - possessed higher values of upper lip thickness followed by Class II div2 then Class II div1, this difference was significant ($P < .05$) between (Class I, II div1), and (class II div1, II div2) and non-significant between (class I, II div2) (Table 3).but at smile position, The Class I subjects possessed higher values of upper lip thickness followed by Class II div2 then Class II div1, this difference was not significant ($P > .05$) between all groups **(Table 5).**

There was no significant difference between males and females in all groups at both rest and smile positions. **(Table 2, 4)**

Change in upper lip length and thickness was significantly higher ($P < .05$) in class I compared with class II div1,2 ,and significantly higher ($P < .05$) in class II div2 compared with class II div1 **(Table 7) .**

Change in upper lip length was significantly higher ($P < .05$) in males compared with females in all groups, and Change in upper
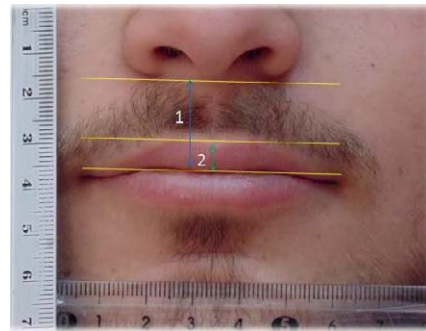

Figure 1 Measurements made on rest position photograph.

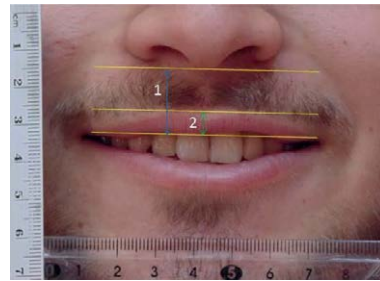(1) Upper lip length (2) Upper lip thickness

Figure 2 Measurements made on smile photograph.

(1)Upper lip length (2) Upper lip thickness

lip thickness was significantly higher ($P < .05$) in males compared with females in class II div1 **(Table 6).**

Discussion

The smile plays an important part in orthodontic diagnosis and treatment planning

The selection of the two frames used in this study was based on the reproducibility of the two expressions. Several studies[12–14] have concluded that the rest position of the lips and posed smile are the reproducible expressions

An important aspect to consider when evaluating smile is the effect of malocclusion and gender on changes of upper lip length and thickness.

The study showed that upper lip length -at rest position- in class I was higher compared with other groups that come in accordance with Rakosi [24] who mentioned that Class II have shorter upper lip than that of Class I subjects.

The upper lip length - at smile position- in class II div1 was higher compared with class I, II div2 and this may due to lack of lips' elasticity in patients with class II of malocclusion, this result come in agreement with Islam et al [25] who mentioned that Both the upper and lower lips in the smile of patients in the Class II division 1 group were positioned downward.

Table 1 Measurement Used in the Study.

Measurement	Description
1. Upper lip length	Distance measured between subnasale and stomion superius
2. Upper lip thickness	Distance measured between labrale superius and stomion superius

Table 2 Descriptive Statistics and Significance of Mean Differences of Rest Position Measurements Between Males and Females.

Measurements in Rest Position Photographs, mm	Group	Sex		P Value
		Male	Female	
		Mean ± SD	Mean ± SD	
Upper lip length	Group 1 Group 2 Group 3	24.91 ± 1.26 23.00 ± 1.30 23.70 ± 1.34	22.36 ± 1.32 21.18 ± 1.29 22.00 ± 1.28	00000* 00000* 00000*
Upper lip thickness	Group 1 Group 2 Group 3	8.28 ± 0.86 7.24 ± 1.18 7.88 ± 0.75	8.16 ± 1.10 7.14 ± 0.74 7.75 ± 0.99	00700 007.0 006.0

* P = .05

Table 3 Comparisons of Rest Position Measurements Between the five Groups With in Males and Within Females.

Comparison	Upper Lip Length		Upper Lip Thickness	
	Male	Female	Male	Female
Group 1 vs group 2	00000*	000.0*	00006*	00000*
Group 1 vs group 3	000.00*	00000*	00000	00000
Group 2 vs group 3	0000.	00.00	000..*	000.7*

* P = .05

Change in upper lip length in class II div1,2 was less than class I, and This results was consistent with the idea that protrusion of upper incisors in class II cases causes decreasing of the lips' elasticity and the muscles' ability to raise the upper lip. According to Islam et al [25] the upward movement of the upper lip in Class II division 1 group was smaller in comparison with the class I group.

The study showed a significant difference between class II div1 and class II div2 in upper lip thickness and in change of upper lip thickness. This result comes in agreement with Tanic et al [26]

Who mentioned that the upper lip thickness was higher in class II div2 compared with class II div1.

On the basis of the results and back to **Tables (2,4)** for overall sample, Class I and IIdiv1,2, a significant sex difference had been seen for upper lip length with males possessed higher value at 0.05 level of probability. Al–T'aani [27] stated that Helman found that the upper lip length show significant difference between two sexes.

Table 4 Descriptive Statistics and Significance of Mean Differences of Smile Measurements Between Males and Females.

Measurements in Rest Position Photographs, mm	Group	Sex		P Value
		Male	Female	
		Mean ± SD	Mean ± SD	
Upper lip length	Group 1 Group 2 Group 3	16.32 ± 1.56 19.00 ± 1.23 18.60 ± 1.31	15.28 ± 1.21 17.60 ± 1.32 18.00 ± 1.04	0000.* 00000* 0.0O.*
Upper lip thickness	Group 1 Group 2 Group 3	6.14 ± 0.96 5.72 ± 1.16 5.88 ± 0.75	6.12 ± 1.09 5.44 ± 0.72 5.76 ± 0.94	00000 00.6. 00600

* P = .05

The vertical changes in upper lip length and thickness were significantly higher in males compared with females; these results come in agreement with Chetan et al [28] who mentioned that Males have more vertical movements whereas females have more horizontal movements during smile.

Conclusions

From present study we may conclude that:

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Table 5 Comparisons of smile Position Measurements Between the five Groups Within Males and Within Females.

Comparison	Upper Lip Length		Upper Lip Thickness	
	Male	Female	Male	Female
Group 1 vs group 2	00000*	00000*	00000	00..0
Group 1 vs group 3	00000*	00000*	00000	00000
Group 2 vs group 3	00000	00000	00000	1.000

* P = .05

Table 6 Descriptive Statistics and Significance of Mean Differences of changes of Measurements Between Males and Females.

Measurements	Group	Sex		
		Male	eFameF	
		Mean ± SD	Mean ± SD	P Value
Change in upper lip length	Group 1 Group 2 Group 3	8.59 ± 0.77 4.00 ± 0.38 5.10 ± 0.21	7.08 ± 0.96 3.58 ± 0.24 4.01 ± 0.99	00000* 00000* 00000*
Change in Upper lip thickness	Group 1 Group 2 Group 3	2.14 ± 0.47 1.52 ± 0.14 2.00 ± 0.24	2.04 ± 0.25 1.70 ± 0.15 1.99 ± 0.14	00.06 00000* 0007.

* P = .05

Table 7 Comparison of the changes of Measurements Between the five Groups Within Males and Within Females.

Comparison	Change in Upper Lip Length		Change in Upper Lip Thickness	
	Male	Female	Male	Female
Group 1 vs group 2	00000*	00000*	0.000*	0.000*
Group 1 vs group 3	00000*	00000*	0.000*	0.000*
Group 2 vs group 3	00000*	00000*	0.000*	0.000*

* P = .05

- Upper lip length at rest and smile was higher in class I compared with other groups.

- Changes in upper lip length and upper lip thickness were higher in class I.

- Upper lip in the smile of patients with Class II division 1 was positioned downward.

- The upward movement of the upper lip (changes in length and thickness) was smaller in Class II div 1 compared with the other groups.

- Males have more vertical movements during smile.

References

1   Sarver DM, Ackerman MB (2003) Dynamic smile visualization and quantification: part 1. Evolution of the concept and dynamic records for smile capture. Am J Orthod Dentofacial Orthop 124: 4-12.

2   Sarver DM, Ackerman MB (2003) Dynamic smile visualization and quantification: Part 2. Smile analysis and treatment strategies. Am J Orthod Dentofacial Orthop 124: 116-127.

3   Hulsey CM (1970) An esthetic evaluation of lip-teeth relationships present in the smile. Am J Orthod 57: 132-144.

4   Rigsbee OH 3rd, Sperry TP, BeGole EA (1988) The influence of facial animation on smile characteristics. Int J Adult Orthodon Orthognath Surg 3: 233-239.

5   Mackley RJ (1993) An evaluation of smiles before and after orthodontic treatment. Angle Orthod 63: 183-189.

6   IÅŸiksal E, Hazar S, AkyalÃ§in S (2006) Smile esthetics: perception and comparison of treated and untreated smiles. Am J Orthod Dentofacial Orthop 129: 8-16.

7   Desai S, Upadhyay M, Nanda R (2009) Dynamic smile analysis: changes with age. Am J Orthod Dentofacial Orthop 136: 310.

8   Formby WA, Nanda RS, Currier GF (1994) Longitudinal changes in the adult facial profile. Am J Orthod Dentofacial Orthop 105: 464-476.

9   Nanda RS, Meng H, Kapila S, Goorhuis J (1990) Growth changes in the soft tissue facial profile. Angle Orthod 60: 177-190.

10 Owens EG, Goodacre CJ, Loh PL, Hanke G, Okamura M, et al. (2002) A multicenter interracial study of facial appearance. Part 2: A comparison of intraoral parameters. Int J Prosthodont 15: 283-288.

11 Owens EG, Goodacre CJ, Loh PL, Hanke G, Okamura M, et al. (2002) A multicenter interracial study of facial appearance. Part 1: A comparison of extraoral parameters. Int J Prosthodont 15: 273-282.

12 Krishnan, V., et al. (2008): Characterization of posed smile by using visual analog scale, smile arc, Buccal corridor measures, and modified smile index. Am J Orthod Dentofacial Orthop, 133: p. 515 23.

13 Tjan AH, Miller GD, The JG (1984) Some esthetic factors in a smile. J Prosthet Dent 51: 24-28.

14 Peck S, Peck L, Kataja M (1992) The gingival smile line. Angle Orthod 62: 91-100.

15 Peck S, Peck L, Kataja M (1992) Some vertical lineaments of lip position. Am J Orthod Dentofacial Orthop 101: 519-524.

16 Peck S, Peck L (1995) Selected aspects of the art and science of facial esthetics. Semin Orthod 1: 105-126.

17 Dong JK, Jin TH, Cho HW, Oh SC (1999) The esthetics of the smile: a review of some recent studies. Int J Prosthodont 12: 9-19.

18 Ackerman MB, Ackerman JL (2002) Smile analysis and design in the digital era. J Clin Orthod 36: 221-236.

19 19.Gavrilovic I. Smile Tipes in Patients with Normal Occlusion and Class II/1 Malocclusion. IJHSSE, 2015; 2: 75-80.

20 Garber DA, Salama MA (1996) The aesthetic smile: diagnosis and treatment. Periodontol 2000 11: 18-28.

21 Peck S, Peck L, Kataja M (1992) The gingival smile line. Angle Orthod 62: 91-100.

22 Weeden JC, Trotman CA, Faraway JJ (2001) Three dimensional analysis of facial movement in normal adults: influence of sex and facial shape. Angle Orthod 71: 132-140.

23 Otta E (1998) Sex differences over age groups in self-posed smiling in photographs. Psychol Rep 83: 907-913.

24 24. Rakosi Th. (1997) Dentofacial Orthopedics With Functional Appliances. (second ed).St. Louis: Mosby, Inc.

25 25. Islam R, Kitahara T, Naher L, Hara A, Nakasima A (2009) Lip morphological changes in orthodontic treatment. Class II division 1: malocclusion and normal occlusion at rest and on smiling. Angle Orthod 79: 256-264.

26 26. TaniÄ T, BlaÅj Z, MitiÄ V (2012) [Analysis of soft tissue thickness in persons with malocclusions of Class II division 1 and Class II division 2]. Srp Arh Celok Lek 140: 412-418.

27 27. Al–T'aani MM. (1996) Soft tissue facial profile analysis: cephalometric study of Iraqi adu-lts. MSc Thesis. College of Dentistry. Uni-versity of Baghdad.

28 28. Chetan P, Tandon P, Singh GK, Nagar A, Prasad V, et al. (2013) Dynamics of a smile in different age groups. Angle Orthod 83: 90-96.

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