Acta Scientific Dental Sciences (ISSN: 2581-4893)

Volume 5 Issue 7 July 2021

Research Article

Gender Differences in Smiling: Class III and Class I Malocclusions

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Received: June 14, 2021

Published: June 29, 2021

Abstract

Introduction: Smile is a significant facial expression that affects the apparent facial attractiveness of a person and is used as an efficient mean for societal communication. This study is to evaluate the smile parameter variations between Class I and Class III male and female subjects. It invests the gender-related changes in the soft tissue for orthodontic diagnostic and proper treatment plans to reach the maximum patient satisfaction.

Materials and Methods: This study was carried out on 60 male and female adults patients aged between 18 and 30 years before orthodontic treatment. Two frontal digital photographs were taken for each subject, one at rest and the other in the posed smile position. Photographs were uploaded on Photoshop software for standardization and then uploaded on the Digital Smile Design software (DSD) where the actual incisogingival height of the central incisor was used for automatic calibration.

Results: The maxillary incisor display was statistically significantly greater for skeletal Class I subjects for both female and male compared to Class III. On the other hand, the percentage of non-consonant and flat smile arcs for skeletal Class III was found to be significantly higher than those in Class I subjects. Skeletal Class III subjects show significantly longer chin height, shorter upper lip length, shorter lower facial height, and less inter-commissural distance than Class I subjects.

Conclusion: Class III for both female and male subjects tended to have wider smile widths, less gingival display, longer chin heights, shorter lower vertical dimensions and a higher percentage of non-consonant and flat smile arcs than normal Class I subjects which should be taken into consideration in planning and designing the mechanics during comprehensive orthodontic treatment of these subjects.

Keywords: Class III; Class I; Gender; Esthetics; Smile

Introduction

Smile schemes a diversity of positive feeling such as pleasures, support, and humor. An esthetical pleasant smile can enhance the self-confidence in societal conditions. Thus, it may not be amazing that a major reason that younger children and their parents look for orthodontic concern is to decrease banter [1]. There have been huge discussions regarding the significance of the smile with respect to the dentofacial features, the community and psychological benefits of enhancing smile esthetics [2].

Esthetics plays a significant function in mitigating orthodontic treatment during childhood and adulthood [3]. Facial look is an essential factor in the insight of facial aesthetics, and the attractiveness of the face influences the perception of the smile character. In this situation, facial look should be taken into consideration in

the orthodontic treatment plans. Additionally, the need to have a beauty, young and healthy look increases in culture, which allows esthetic consideration to be more significant in treatment planning. Therefore, smile esthetics became the main spotlight of patients searching orthodontic treatment [4].

Several authors [5-7] conducted a study on the effect of maxillary incisors, lower lip, and gingival display relationship on smile attractiveness in female and male adults. They illustrated that the esthetic smile needs the interactions of different factors. Improving these factors is essential for orthodontists as smile attractiveness is the factor that many patients use to evaluate the achievement of orthodontic treatment. Thus, the complex relations among smile components associated with occlusal functions must be considered to get ideal useful and esthetic result. Lima., *et al*. [8] and Pithon., *et al*. [9] studied the influence of facial pattern in smile attractiveness for both female and male adults. They investigated that the conception of an ideal smile depends on tooth morphology, color, relative relations between teeth, lips, and gingival. Godinho., *et al*. [10] studied the role of facial parameters to the attractiveness of the smiling face in male and female patients. They found that the malocclusions affect the insight of attractiveness, intelligence, personality, and behaviors. Olsen and Inglehart [11] showed that persons with a regular occlusion are more attractive, intelligent, pleasant and extroverted; anterior crossbites cause negative insights, and people with numerous diastemas seem as the least reliable and pleasant. Another study of the influence of teeth arrangement on personality investigated that people with perfect smile are elegant and more suitable for jobs [12].

Since patients became more care about the esthetics of their smile, orthodontists have to be interested in the soft tissue structure. It would be careful to assess the components of a smile prior to treatment to decide the needed action and to be in touch with the patient and parents [13,14].

Aim of the Study

The aim of the present study is to assess the smile parameter variations among Class I and Class III male and female subjects, investigating the gender-related changes in the soft tissue for orthodontic diagnostic and proper treatment plans to meet the smile requirements for each gender.

Materials and Methods

The current study was performed on 60 skeletal Class III and Class I male and female subjects with average vertical facial patterns selected from the Orthodontic Department, Faculty of Oral and Dental Medicine, Future University, Egypt. In a previous study by Kakadiya., *et al*. [15] the response within skeletal Class I and III groups was normally distributed true difference between the study groups was 1.42.

Sample size calculation indicated that for a study with a power of 80% and an α error of 0.05, the lowest predictable sample size was 9 cases per group for a total of 18 cases. 60 male and female adults were included in the present study, according to the skeletal discrepancy whether mandibular excess or maxillary deficiency, divided into two groups which included 30 for each group. Subjects included in the study had an average age of 18 30 years in order to minimize the effects of growth on facial appearance as reported by Leonardi., *et al*. [16] whereas those with congenitally missing, malformed or extracted teeth, having fixed bridges or crowns visible on smiling, extreme dental attrition, lip irregularity or history of lip surgery and facial asymmetries were excluded from the study. Two frontal photographs at rest and subjects' commissuretocommissure posed smile were taken by a Canon G11 camera set on a tripod from a fixed distance of 1.5m where the camera was focused on the mouth showing from the nose to the chin. The camera lens was adjusted to be parallel to the floor by adjusting the mount-head of the tripod guided by the leveling indicator that is built in the tripod. Photographs were taken for each patient in the natural head position. The head was held in an upright posture and eyes were focused on a point in the distance at eye level such that the visual axis was horizontal. For measuring smile variables the DSD software program was used. Standardization was mandatory to avoid any magnification errors where the incisogingival height of the right and left maxillary central incisors, lateral incisor and the canine were clinically measured (actual height) for each case using a vernier caliper to the nearest 0.1 mm found to be the same (Figure 1 and 2). Photographs were uploaded on Photoshop software for standardization and a reading for the incisogingival height of the right maxillary central incisor was done where a ratio of 7:5, as reported by Nouh AS., *et al*. [17] provides the most accurate image guided by the actual clinical height of the central incisor. The new standardized photos were uploaded on the digital smile system (DSD) software to be calibrated to measure all linear variables in to the nearest 0.1 mm. The actual incisogingival height in millimeters was used for automatic calibration by the digital smile system DSS where twelve smile components were evaluated at rest and on smiling. These smile components are defined in table 1.

Figure 1: Incisogingival height of the maxillary incisors.

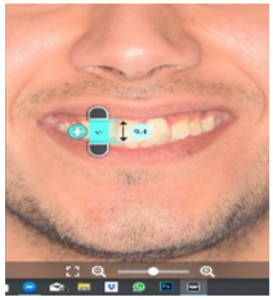

Figure 2: Measuring incisor height using digital smile design (DSD).

(A) Soft tissue Esthetic Analysis in the Rest Position	
Variable	**Brief definition**
Upper lip length	The distance between the base of the nose (Subnasale) and the inferior part of the upper lip (Stomion superius) ($Stom_s$).
Upper lip thickness	The vertical distance from the most superior point of the cuspid's bow to the most inferior portion of the tubercle of the lower lip
Intercommissural distance	The horizontal distance between two parallel lines extending vertically from the corners of the mouth
Lower lip thickness	Vertical distance between Stomion (Stom) to Labrale inferius (Li).
Lower lip length	The vertical distance from Stomion (Stom) to Sulcus inferius (Si).
Chin height	The vertical distance from Sulcus inferius (Si) to soft tissue Gnathion (Gn').
B-Soft tissue Esthetic Analysis on smiling	
Maxillary incisor display	The amount of vertical tooth exposure during smiling
Buccal corridor	The distance between the most distal maxillary dentition and the commissure.
Gingival display	The amount of maxillary gingival exposure between inferior border of upper lip and marginal gingiva of maxillary central incisors in mm.
Smile width	The horizontal distance between the left outer commissure to the right outer commissure of the lips on smiling.
Smile arc	The relationship of the curvature of the incisal edges of the maxillary incisors and canines to the curvature of the lower lip in the posed smile. The ideal smile arc has the maxillary incisal edge curvature parallel to the curvature of the lower lip.

Table 1: Brief definition of the studied smile characteristics.

Statistical analysis

Numerical data were illustrated for normality by checking the distribution of data and through tests of normality (Kolmogorov-Smirnov and Shapiro-Wilk tests). All data illustrated normal (parametric) distribution excluding the gingival display which showed nonnormal (nonparametric) distribution. Data are presented as means, standard deviation (SD), mean difference and 95% confidence interval (95% CI) for the difference values. For parametric data, Student's t test was used to compare between the two Classes. For nonparametric data, Mann-Whitney U test was used to compare between men of both Classes. The frequencies, percentages (%) and results of Fisher's exact test for comparison between smile arcs of Class I and Class III men on smiling are represented. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM SPSS Statistics for Windows, version 23.0. Armonk, New York: IBM Corp.

Results

Inter-observer reliability (agreement)

All measurements were repeated for 10 frontal photographs by the main observer and another observer. There was good to very good inter-observer reliability (agreement) regarding all measurements of Class I cases with Cronbach's alpha values ranging from 0.608 to 0.812. Similarly with Class III cases; there was good to very good inter-observer reliability (agreement) regarding all measurements with Cronbach's alpha values ranging from 0.611 to 0.812 (Table 2).

Soft tissue analysis of class I females and males at rest

The resulting data of the measured components for both males and females at rest are given in table 3. In Class I subjects, the upper lip length, lower lip thickness and the lower facial height were found to be statistically insignificant for both genders.

The lower lip length and intercommisure distance were significantly longer in females than males. On the other hand, males showed statistically significant longer chin heights than females.

Soft tissue analysis of class I females and males on smiling

The comparison between smile components for both male and female adults on smiling is investigated in table 4 and 5. The results show that the maxillary incisor display, the buccal corridor, the gingival display and the smile width were all statistically significantly higher in females than males. No significant difference in smile arcs between both genders.

Class	Measurement	Cronbach's alpha	ICC	Measurement error
Class I	Upper lip thickness	0.712	0.688	0.2
	Upper lip length	0.685	0.642	0.12
	Inter-commissural width	0.715	0.695	0.82
	Lower facial height	0.608	0.556	0.53
	Lower lip thickness	0.759	0.716	1.00
	Lower lip length	0.812	0.793	0.36
	Chin height	0.745	0.711	0.55
	Maxillary incisor display	0.732	0.704	0.67
	Buccal corridors	0.747	0.694	0.66
	Gingival display	0.791	0.758	0.37
	Smile width	0.688	0.649	0.74
	Smile height	0.700	0.685	0.95
Class III	Upper lip thickness	0.644	0.581	0.67
	Upper lip length	0.719	0.682	0.91
	Inter-commissural width	0.701	0.667	0.98
	Lower facial height	0.611	0.575	1.18
	Lower lip thickness	0.800	0.765	0.44
	Lower lip length	0.740	0.706	1.02
	Chin height	0.692	0.661	0.94
	Maxillary incisor display	0.736	0.712	0.84
	Buccal corridors	0.755	0.716	0.78
	Gingival display	0.816	0.800	0.67
	Smile width	0.652	0.633	1.18
	Smile height	0.726	0.711	0.99

Table 2: Results of Cronbach's alpha reliability coefficient and intra-class correlation coefficient (ICC) for inter-observer reliability.

Measurement (mm)	Females (n = 15)		Males (n = 15)		Mean Difference (mm)	95% CI for Difference		P-value	Effect size (d)
	Mean (mm)	SD	Mean (mm)	SD		Lower bound	Upper bound		
Upper lip length	19.72	2.03	20.27	2.29	-0.55	-2.17	1.07	0.495	0.254
Upper lip thickness	6.29	1.18	5.9	0.96	0.39	-0.41	1.2	0.324	0.363
Inter-commissural width	52.08	6.04	47.58	2.78	4.5	0.99	8.01	0.014*	0.957
Lower facial height	61.65	6.31	64.62	2.76	-2.97	-6.61	0.67	0.106	0.610
Lower lip thickness	16.2	2.04	15.37	2.35	0.83	-0.81	2.48	0.309	0.379
Lower lip length	23.9	1.93	22.0	1.89	1.9	0.47	3.33	0.011*	0.995
Chin height	37.09	3.76	42.37	3.61	-5.28	-8.03	-2.53	0.001*	1.434

Table 3: Mean, standard deviation (SD), 95% confidence interval (95% CI) and results of student's test for comparison of soft tissue measurements between class I females and males at rest.

*: Significant at P ≤ 0.05.

Measurement (mm)	Females (n = 15)		Males (n = 15)		Mean Difference (mm)	95% CI for Difference		P-value	Effect size (d)
	Mean (mm)	SD	Mean (mm)	SD		Lower bound	Upper bound		
Maxillary incisor display	9.67	1.52	8.11	0.97	1.56	0.61	2.51	0.002*	1.224
Buccal corridor	8.99	1.74	7.01	0.91	1.97	0.94	3.01	0.001*	1.426
Gingival display	3.20	2.15	0.53	1.11	2.67	1.39	3.95	0.001*	1.367 †
Smile width	68.68	6.24	60.66	6.22	8.02	3.36	12.68	0.001*	1.287

Table 4: Mean, standard deviation (SD), 95% confidence interval (95% CI), results of student's test and Mann-Whitney U test for comparison of soft tissue measurements between class I females and males on smiling.

*: Significant at P ≤ 0.05, †: Mann-Whitney U test.

	Females (n = 15)		Males (n = 15)		P-value	Effect size (v)
	n	%	n	%		
Consonant	14	93.3	14	93.3	1.000	0.000
Not consonant	1	6.7	1	6.7		
Flat	0	0	0	0		

Table 5: Comparison of frequencies, percentages (%) and results of Fisher's Exact test of smile arcs between Class I females and males.

*: Significant at P ≤ 0.05.

Soft tissue analysis of class III females and males at rest

The comparison between smile components for both male and female adults at rest is illustrated in table 6. In Class III subjects, the upper lip length, intercommissure width and the lower facial height were all found to be statistically significantly higher in males than females. The upper, lower lip thickness and chin height was found to be statistically insignificant.

Measurement (mm)	Females (n = 15)		Males (n = 15)		Mean Difference (mm)	95% CI for Difference		P-value	Effect size (d)
	Mean (mm)	SD	Mean (mm)	SD		Lower bound	Upper bound		
Upper lip length	16.44	2.17	19.92	3.82	-3.48	-5.8	-1.16	0.005*	1.120
Upper lip thickness	6.14	1.49	6.11	1.7	0.03	-1.17	1.22	0.964	0.019
Inter-commissure distance	40.47	3.44	48.56	5.68	-8.09	-11.61	-4.58	<0.001*	1.723
Lower facial height	52.31	4.88	60.79	6.97	-8.49	-12.99	-3.99	0.001*	1.409
Lower lip thickness	15.93	2.46	14.07	3.26	1.87	-0.3	4.03	0.088	0.646
Lower lip length	22.47	3.76	22.03	2.99	0.43	-2.11	2.97	0.729	0.127
Chin height	43.93	5.32	42.67	6.97	1.27	-3.37	5.9	0.580	0.204

Table 6: Mean, standard deviation (SD), 95% Confidence Interval (95% CI) and results of student's test for comparison of soft tissue measurements between Class III females and males at rest.

*: Significant at P ≤ 0.05.

Soft tissue analysis of class III females and males on smiling

The results of the measured components for both males and females on smiling are given in table 7 and 8. The maxillary incisor display and smile widths showed statistically significantly higher results in Class III females than class III males. While, the buccal corridor, gingival display and smile arcs showed no statistically significant difference among class III females and class III males.

Measurement (mm)	Females (n = 15)		Males (n = 15)		Mean Difference	95% CI for Difference		P-value	Effect size (d)
	Mean	SD	Mean	SD		Lower bound	Upper bound		
Maxillary incisor display	9.13	2.16	6.47	2.08	2.66	1.08	4.24	0.002*	1.254
Buccal corridors	8.57	1.51	8.28	2.59	0.29	-1.29	1.88	0.708	0.137
Gingival display	1.03	2.31	0.44	1.17	0.59	-0.77	1.96	0.544	0.144 †
Smile width	77.55	13.16	67.17	7.44	10.39	2.39	18.38	0.013*	0.971

Table 7: Mean, standard deviation (SD), 95% Confidence Interval (95% CI), results of student's test and Mann-Whitney U test for comparison of soft tissue measurements between Class III females and males on smiling.

*: Significant at P ≤ 0.05, †: Mann-Whitney U test.

	Females (n = 15)		Males (n = 15)		P-value	Effect size (v)
	N	%	n	%		
Consonant	9	60	9	60	0.463	0.283
Not consonant	4	26.7	5	40		
Flat	2	13.3	0	0		

Table 8: Frequencies, percentages (%) and results of Fisher's Exact test for comparison between smile arcs of Class III females and males.

*: Significant at P ≤ 0.05.

Discussion

In this study, Class III females showed significantly shorter lower facial height, less intercommisure width and shorter upper lip length compared to Class I females. However, significantly wider smile width and less gingival display were seen for Class III females on smiling which could be due to the influence of the shorter lower facial height and the vertical position of the maxilla seen in Class III female subjects.

Although the lower facial height was less in Class III females, the chin height was found to be significantly longer compared to Class I females which could be attributed to the morphological mandibular pattern of skeletal Class III subjects. On the other hand, insignificant difference was found for the buccal corridor, maxillary incisor display, and smile arc consonance between females of both skeletal groups.

Females of both skeletal patterns showed greater maxillary incisor display and smile width than males. This was in agreement with Jeelani., *et al*. [18] who stated that maxillary incisor display was more significant in females than males. On the other hand, Class III males showed significantly upper lip length, inter-commissural distance than Class III females which was in accordance with Stephanie and Jonas [19]. On the other hand, it disagrees with Kakadiya., *et al*. [15] who reported that females had significantly wider intercommissure width than males.

Class I females showed greater gingival display and longer lower lip length than Class I males which came in contrast to Tjan., *et al*. [20] and Peck., *et al*. [21] who stated that males had higher soft tissue values than females. The intercommissure width was significantly wider for Class I females compared to Class I male subjects which came in contrast to Sachdeva., *et al*. [22] who illustrated that the intercommisure width was significantly wider in males.

The mean buccal corridor for Class I females was significantly larger than that for Class I males, which does not agree with the results of Sachdeva., *et al*. [22] who showed insignificant difference for buccal corridors between both genders. The chin height showed insignificant gender difference for skeletal Class III subjects. However, it was significantly longer for Class I males compared to Class I females which came in contrast to Farhad., *et al*. [23] who reported that chin height was more significant in females than males.

The percentage of consonant smile arcs was insignificantly different between both males and females for both skeletal groups which were not in agreement with the studies described by Sabri., *et al*. [24] and Câmara [13] who proved that smile arcs were more consonant in females than males.

Conclusion

From the above study one can draw the following conclusions:

- At rest, the lower lip length and intercommisure distance were significantly longer in females of Class I than males. Additionally, males showed statistically significant longer chin heights than females. On the other hand, in Class III subjects, the upper lip length, intercommissure width and the lower facial height were all found to be statistically significantly higher in males than females.
- On smiling, in the maxillary incisor display, the buccal corridor, the gingival display and the smile width were all statistically significantly higher in females of Class I than males. On the other hand, the maxillary incisor display and smile widths showed statistically significantly higher results in Class III females than Class III males.

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