Evaluation of smile characteristics of skeletal Class III compared to skeletal Class I female adults

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Abstract

OBJECTIVE: Esthetic enhancement plays an important role in orthodontic treatment. This study was conducted on females as most girls have their growth spurt at a younger age than boys do, so their demand to facial esthetics, especially those who have residual growth of mandible producing class III effect, requires full understanding to smile features helping in diagnosis and treatment planning for maximum patient satisfaction.

MATERIALS AND METHODS: This study was conducted on 30 skeletal Class III and Class I female adults (18–30 years old) who were divided equally into two groups comprising 15 each. Two frontal digital photographs were taken for each subject, one at rest and the other in the posed smile position. Photographs were taken for each subject in the natural head position by a Canon EOS 1200 D camera set on a tripod at a distance of 1.5 m. The incisogingival height of the right maxillary central incisor was clinically measured using a vernier caliper to the nearest 0.1 mm. 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. Esthetic components at rest and on smiling were measured for both groups; all linear variables were measured to the nearest 0.1 mm.

RESULTS: Class III females tended to have wider smile widths, less gingival display, longer chin heights, shorter lower vertical dimensions, and a higher percentage of nonconsonant and flat smile arcs than Class I subjects.

CONCLUSIONS: The components of the smile should be considered as a guide to help in planning and designing the mechanics during comprehensive orthodontic treatment.

Keywords: Class III females adults, esthetics, malocclusion, smile non

Introduction

The smile has an essential responsibility in social interaction. It assigns various positive emotions like pleasure, endorsement, and humor. Esthetically pleasant smile might enhance the self-confidence in social positions.[1] Dentofacial beauty is mainly significant to a person’s psychosocial well-being, where persons with a regular dental look seem more socially nice-looking than those with malocclusions. Those with deprived dental esthetics have been related to need of self-confidence and are considered to be disadvantaged in social, educational, and occupational settings.[2] Thus, smile esthetics has become the primary focus of patients seeking orthodontic treatment. Now smile analysis represents an essential requirement in present orthodontic treatment planning that permits distinguishing positive and negative basics in a patient’s smile.[3] On the other hand, Digital Smile Design (DSD) orderly procedure is dependent on definite

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photographs and software analysis and is globally used. DSD assists the dentists in creating and developing a route of treatment, particularly in a multidisciplinary approach. Also, it supplies a virtual simulation of the concluding result. In addition, it allows communications between the dental team and the patient. An additional feature of DSD is that it enables analysis of the proportions and aesthetics of teeth, smile and face, and allows the feasibility of enhancing the certainty of concluding plan outcome.4

Several studies have evaluated smile features and their influences on attractiveness. Sabri investigated that Class I subjects obsessed superior values of upper lip length than Class II followed by Class III. It was concluded that the upper lip length was greater in Class I subjects, whereas Class III subjects had greater lower lip lengths. The interlabial gap was larger in Class II subjects, whereas the coverage of the lower lip to incision superius was greater for Class III subjects. Rashed and Heravi evaluated the impact of different malocclusions (Classes I, II, and III) on lip-tooth relationships during smiling using video images. There were no statistically major divergence in the upper central incisor display and buccal corridor ratios among the malocclusion groups. Additionally, Malhotra et al. studied the effect of specific facial hard and soft tissues on smile characteristics. It was observed that patients with Class III showed the slightest quantity of buccal corridors and gingival display on smiling. Smile analysis and getting average for different smile components provides strategy for the construction of an esthetic smile. Thus, this study was conducted on females as most girls have their growth spurt at a younger age than boys do, so their demand to facial esthetics, especially those who have residual growth of mandible producing class III effect, requires full understanding to smile features helping in diagnosis and treatment planning for maximum patient satisfaction.

Materials and Methods

The study was carried out on 30 skeletal Class III and Class I female adult 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., 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 minimum estimated sample size was 9 cases per group for a total of 18 cases. 30 females were included in the current study which was equally divided into two groups which included 15 adult females 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., females with skeletal class III (mandibular hyperplasia) and class I facial profiles with average vertical facial pattern, full set of permanent dentition and had not received any pervious orthodontic treatment, whereas those with congenitally missing, malformed or extracted teeth, having fixed bridges or crowns visible on smiling, excessive dental attrition, lip irregularity or history of lip surgery and facial asymmetries were excluded from the study. Two frontal photographs at rest and subjects’ commissure-to-commissure posed smile were taken by a Canon G11 camera set on a tripod from a fixed distance of 1.5 m 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 mounthead 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 maxillary central incisor was clinically measured (actual height) for each case using a vernier caliper to the nearest 0.1 mm. 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 was found to provide the most accurate image guided by the actual clinical height of the central incisor. The new standardized photos were uploaded on the 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 [Figures 1 and 2].

Statistical analysis

Numerical data were investigated for normality by checking the distribution of data and via
tests of normality (Kolmogorov–Smirnov and Shapiro–Wilk tests). All data showed normal (parametric) distribution except for 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 females of both Classes. 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. All measurements were repeated for 10 frontal photographs at two different occasions by the main observer where there was good to very good intra-observer reliability (agreement) regarding all measurements with Cronbach \( \alpha \) values ranging from 0.614 to 0.862.

### Results

Means, SD, 95% CI and results of student’s t-test for comparison between esthetic soft tissue measurements for Class III and I females at rest and on smiling are presented in Tables 1 and 2. The frequencies, percentages (%) and results of Fisher’s exact test for comparison between smile arcs of Class I and Class III females on smiling are represented in Table 3.

At rest, the upper lip length (19.72 mm ± 2.03), inter-commissural distance (52.08 mm ± 6.04) and the

![Figure 1: (1) Upper lip length, (2) Upper lip thickness, (3) Intercomissure width, (4) Lower facial height, (5) lower lip thickness, (6) Lower Lip length and (7) Chin height](image1)

![Figure 2: (1) Incisor display, (2) Buccal corridors, (3) Gingival display, (4) Smile width and (5) Smile arc](image2)

Table 1: Comparison between soft tissue measurements of Class III and Class I females at rest

| Measurement (mm)          | Class I (n=15) | Class III (n=15) | Mean difference (mm) | 95% CI for Difference | P     | Effect size (d) |
|---------------------------|----------------|------------------|----------------------|-----------------------|-------|-----------------|
| At rest                   |                |                  |                      |                       |       |                 |
| Upper lip length          | 19.72          | 2.03             | 16.44                | 2.17                  | 3.28  | 1.71            |
| Upper lip thickness       | 6.29           | 1.18             | 6.14                 | 1.49                  | 0.15  | -0.85           |
| Inter-commissural distance| 52.08          | 6.04             | 40.47                | 3.44                  | 11.61 | 7.94            |
| Lower facial height       | 61.65          | 6.31             | 52.31                | 4.88                  | 9.34  | 5.13            |
| Lower lip thickness       | 16.20          | 2.04             | 15.93                | 2.46                  | 0.27  | -1.43           |
| Lower lip length          | 23.9           | 1.93             | 22.47                | 3.76                  | 1.43  | -0.8            |
| Chin height               | 37.09          | 3.76             | 43.93                | 5.32                  | 6.84  | -10.29          |

*Significant at \( P \leq 0.05 \)

Table 2: Comparison of soft tissue measurements between females with Class III and I on smiling

| Measurement (mm)          | Class I (n=15) | Class III (n=15) | Mean difference (mm) | 95% CI for Difference | P     | Effect size (d) |
|---------------------------|----------------|------------------|----------------------|-----------------------|-------|-----------------|
| Maxillary incisor display | 9.67           | 1.52             | 9.13                 | 2.16                  | 0.54  | -0.86           |
| Buccal corridors          | 8.99           | 1.74             | 8.57                 | 1.51                  | 0.42  | -0.8            |
| Gingival display          | 3.20           | 2.15             | 1.03                 | 2.31                  | 2.17  | 0.5             |
| Smile width               | 68.68          | 6.24             | 77.55                | 13.16                 | \( \neg 8.87 \) | -16.6          |

*Significant at \( P \leq 0.05 \), Mann-Whitney U test
lower facial height (61.65 mm ± 6.31) were found to be significantly longer for skeletal Class I females compared to Class III females. On the other hand, the chin height (43.9 ± 5.32) was significantly longer for Class III females compared to Class I. There was an insignificant difference for the lower lip length, upper and lower lip thickness between both groups [Table 1 and Figure 3].

On smiling, the gingival display of Class I females was found to be significantly greater (3.20 mm ± 2.15) than that for Class III females (1.03 mm ± 2.31) \((P = 0.008, \text{effect size} = 0.988)\). On the other hand, the smile width was significantly wider for skeletal Class III females (77.55 mm ± 13.16) compared to Class I females (68.68 mm ± 6.24) \((P = 0.026, \text{effect size} = 0.861)\). Statistically insignificant differences were found for maxillary incisor display and buccal corridors between both groups [Table 2 and Figure 4].

Class III females had 60% consonant smile arcs, 26.7% nonconsonant and 13.3% flat smile arcs which were found to be statistically insignificant between females of both classes \((P = 0.095, \text{effect size} = 0.404)\) [Table 3 and Figure 5].

### Discussion

This study seeks to determine the smile characteristics of skeletal Class III compared to skeletal I female adult subjects. Two full face frontal photographs were taken for each participant at rest and with posed smile which is considered to be the most reproducible smile according to Ackerman et al.\(^{[11]}\). According to Mack\(^{[12]}\) and Peck et al.\(^{[13]}\), the essential characteristic of the smile that influences esthetics is the quantity of maxillary gingival display. Hulsey\(^{[14]}\) and Mackley\(^{[15]}\) investigated that the upper lip must be at the height of the gingival margin of the maxillary central incisors in an attractive smile. In addition, Ker et al.\(^{[16]}\) stated that the ideal value for smile esthetics was 2.1 mm of gingival display. In this study, the gingival display for skeletal Class III females was (1.03 mm) which was found to be significantly less than that seen for Class I females which was (3.2 mm) which was slightly more than the ideal amount of gingival display as reported by Chiche and Pinault\(^{[17]}\) who pointed out that the esthetically perfect quantity of visible gingiva was about 1 mm but showed that 2–3 mm of gingiva might be esthetically satisfactory.

Although the upper lip length was significantly longer for Class I compared to Class III females, the gingival display was found to be greater in Class I females which could be due to the significantly longer lower facial height shown for Class I compared to Class III females in this study. According to Singer\(^{[18]}\) & Peck and Peck\(^{[13]}\) those with gingival smiles were not only affected by the upper lip length however, they were influenced by vertical maxillary excess and greater muscular capacity to raise the lips. Although the intercommissure width at rest was found to be significantly wider for skeletal Class I females, the smile width was found to be significantly wider for Class III females which disagree with the results
of Malhotra et al.[8] who showed that subjects with Class I showed maximum smile width. Abraham et al.[9] reported a positive correlation between the lower facial height and smile width which was in contrast to the findings of this study where Class III females showed wider smile widths associated with reduced lower facial height. In this study, Class III females showed significantly longer chin height which could be due to the prognathic mandibular pattern found for skeletal Class III subjects. The impact of buccal corridors on smile esthetics was investigated by Gracco et al.,[20] Ker et al.,[21] and Martin et al.[22] who concluded that large buccal corridors were considered less attractive. On the other hand, McNamara et al.[22] and Roden-Johnson et al.[23] and Sachdeva et al.[24] didn’t find connection between buccal corridors and smile esthetics. In this study, the buccal corridor was found to be insignificantly different between both skeletal patterns which came in agreement with Malhotra et al.[8] who pointed out that buccal corridors in Class III subjects did not influence the smile.

Sarver[25] focused on getting the perfect consonant smile arc which was illustrated by the curvature of the maxillary incisal edges being parallel to the curvature of the lower lip that was similar to the conception of Parekh et al.,[26] Yoon et al.[27] and Hulsey[28] who pointed out that a flat smile arc would noticeably decrease the attractiveness of smile. In this study, nonconsonant and flat smile arcs represented a higher percentage in Class III compared to Class I females however, it was statistically insignificant which was in agreement with Rashed and Heravi[27] who concluded that insignificant difference in smile arcs were found among all malocclusions. Badran and Mustafa[28] highlighted that a reverse and flat smile arc had a negative effect on smile esthetics and that the clinician should avoid flat smile arcs to achieve esthetic smiles.

Conclusion

Class III females tended to have wider smile widths, less gingival display, longer chin heights, shorter lower vertical dimensions and a higher percentage of nonconsonant and flat smile arcs than normal Class I subjects, whereas, at rest, Class I females showed significantly longer upper lip length and wider intercommissural distance than Class III females.

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Conflicts of interest

There are no conflicts of interest.

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