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Journal of Contemporary Orthodontics

Journal homepage: https://www.jco-ios.org/

Original Research Article

An evaluation and comparison of smile characteristics of female adults in high angle, medium angle and low angle skeletal types – An observational study

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ARTICLE INFO

Article history:
Received 25-12-2023
Accepted 01-02-2024
Available online 08-02-2024

Keywords:
Smile characteristics
Skeletal types
Orthodontic treatment
Females

ABSTRACT

Aim: To evaluate and compare the smile characteristics of female adults in high angle, medium angle and low angle skeletal types.

Materials and Methods: Frontal photograph at posed smile of 45 adult females were taken with the help of Canon 1500D camera. These photographs were standardized and uploaded on to the Medit Link software. Various smile characteristics like upper lip length, upper lip thickness, lower facial height, lower lip thickness, lower lip length, chin height, incisor display, buccal corridors, gingival display and smile width were measured. Descriptive statistics were carried out for the data and ANOVA test was done for comparison among the types.

Result: P-value more than 0.05 was taken to be significant. It was seen significant for gingival display and chin height in high angle types. The mean for gingival display was 2.26 mm in high angle types (P=0.000531). The mean for chin height was 34.84 mm in high angle types (P=0.016198). Smile width also showed significant results in low angles types. The mean for smile width was 63.88 mm in low angle types.

Conclusion: The significant differences were seen to be in gingival display and chin height in high mandibular females, showing longer chin and more gingival display. In low mandibular angle females, it was seen that they have a broader smile. No significant angle wise differences were seen in other parameters.

1. Introduction

In recent years, the soft tissue paradigm has reemerged in orthodontics, with an increased emphasis on the soft tissues surrounding the mouth in general and the smile in particular. Getting a gorgeous smile is always the primary goal of any cosmetic dentistry procedure. After all, the difference between an acceptable and pleasant esthetic outcome for a particular treatment is the attractiveness of the smile.[1]

Several studies showed smile features and their influence on attractiveness. It was found that the optimum smile was mainly by an upper lip that reaches the gingival margins, with an upward or straight curvature between the philtrum and commissures, an upper incisal line that was coincident with the border of the lower lip, small or no lateral negative space, a commissural line and frontal occlusal plane parallel to the pupillary line and dental and gingival components in harmony.[2]

To diagnose, plan and create a transdisciplinary, esthetically pleasing, and functional end smile new technologies[3,4] and software[5–7] has been developed. Patients' contentment with their quality of life and self-esteem is largely influenced by their facial appearance and smile esthetics in particular.[8] The treatment's success is still largely determined by the final cosmetic outcome.

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https://doi.org/10.18231/j.jco.2024.005

For the best outcomes, dynamic dentofacial examination of the interaction between the lips, teeth and face should be documented.[9]

Smile design software is used to simulate the treatment outcome and can be a bridge of communication between the orthodontist and the patient. The software also helps in analyzing the proportions and esthetics of teeth, smile and face, and allows the feasibility of enhancing the certainty of concluding planned outcomes.[2]

According to the literature reviewed, no such study has evaluated the smile characteristics in high angle, medium angle and low angle cases to the best of our knowledge. Thus, this study was taken up to increase understanding of features of a smile in such cases and to help in diagnosis and treatment planning for maximum patient satisfaction.

2. Materials and Methods

The present study was done on patients registered with the Department of Orthodontics, Manubhai Patel Dental College, Hospital & O.R.I. and requiring fixed orthodontic treatment and fulfilling inclusion criteria.

Females having a full set of permanent dentition and not having received any previous orthodontic treatment were included in the study.

Females having congenitally missing, malformed, or extracted teeth, having fixed bridges or crowns visible on smiling, excessive dental attrition, lip irregularity or history of lip surgery, facial asymmetries and the patients who did not give consent were excluded from the study.

2.1. Materials

1. Canon D1500 camera
2. Picasa Software
3. MeditLink Software
4. Lateral Cephalogram (with standardized magnification 1:1 EZ3D-i software and Vatech smart plus CBCT machine)

Patients were divided into high angle, medium angle and low angle on Lateral cephalogram by measuring the angle SN-MP(here the MP is taken as Go-Me).[10]

1. If this angle was less than 26°, it was considered as low angle type.
2. If this angle was more than 38°, it was considered as high angle type.
3. If this angle was more than 26° and less than 38°, it was considered as medium angle type.

3. Standardization for Photographs

One frontal photograph at the females' commissure-to-commissure posed smile was taken by a Canon D1500 camera set at a distance of 1.5 m where the camera was focusing on the mouth showing from the nose to the chin. The camera lens was adjusted to be parallel to the floor. The photograph was taken of each female in the natural head position.

For measuring smile variables the MeditLink software program was used. For standardization, to avoid any magnification errors where the inciso-gingival 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 Picasa 3 software for standardization and reading for the inciso-gingival height of the right maxillary central incisor was done where a ratio of 4:3 is found to provide the most accurate image-guided by the actual clinical height of the central incisor. In order to calibrate the new standardized pictures and measure all linear variables to the closest 0.1 mm, they were uploaded to the MeditLink program. The MedlitLink automatically calibrated the grin components based on the patient's real inciso-gingival height in millimeters when the female smiled.

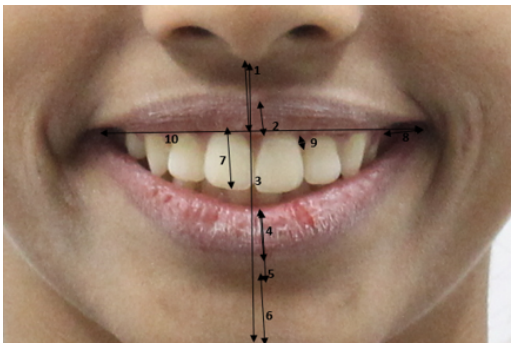

Figure 1: 1 upper lip length; 2 upper lip thickness; 3 lower facial height; 4 lower lip thickness; 5 lower liplength; 6 chin height; 7 incisor display; 8 buccal corridors; 9 gingival display; 10 smile width

The characteristics that were studied are (Figure 1) -

1. Upper lip length (distance between subnasale and stomion superius.)
2. Upper lip thickness (from upper lip line to labrale superioris)
3. Lower facial height (vertical distance between subnasale to soft tissue menton)
4. Lower lip thickness (distance between stomion to labrale inferius)
5. Lower lip length (vertical distance between stomion to sulcus inferius)
6. Chin height (distance from sulcus inferius to soft tissue gnathion)
7. Incisor display (amount of tooth exposure during smiling)
8. Buccal corridors (distance between distal most dentition and the commissure)

9. Gingival display (amount of gingival exposure during smiling)
10. smile width (Horizontal distance between the outer commissures of the lips on smiling)

3.1. Sample size

Minimum 44 (15 per group in 3 groups) females were studied at 95% confidence with 5% relative precision, to estimate mean smile width of female patients as 77.55 mm with SD 13.16.[2]

3.2. Statistical plan

Descriptive statistics was performed to know about the smile characteristics among the types. ANOVA test was done to compare the smiles characteristics among the different types.

4. Results

A total of 45 females were included in the study divided into 3 groups with 15 each. A descriptive analysis was done for all the groups to know mean and deviation among the parameters. ANOVA test was done for all the parameters for comparison among the groups.

Table 1 shows the descriptive analysis among the high angle types. This table shows the mean of all the parameters for the high angle types.

Table 2 shows the descriptive analysis among the medium angle types. This table shows the mean of all the parameters for medium angle types.

Table 3 shows the descriptive analysis among the low angle types. This shows the mean of all the parameters for low angle types.

Table 4 shows the results of ANOVA test among the types for upper lip length.

Here P value is 0.831522 which is more than 0.05. Hence, null hypothesis is accepted which suggests no difference angle-wise in upper lip length.

Table 5 shows the results of ANOVA test among the types for upper lip thickness.

Here P value is 0.46364 which is more than 0.05. Hence, null hypothesis is accepted which suggests no difference angle-wise in upper lip thickness.

Table 6 shows the results of ANOVA test among the types for lower facial height.

Here P value is 0.836234 which is more than 0.05. Hence, null hypothesis is accepted which suggests no difference angle-wise in lower facial height.

Table 7 shows the results of ANOVA test among the types for lower lip thickness.

Here P value is 0.865775 which is more than 0.05. Hence, null hypothesis is accepted which suggests no difference angle-wise in lower lip thickness.

Table 8 shows the results of ANOVA test among the types for lower lip length.

Here P value is 0.505242 which is more than 0.05. Hence, null hypothesis is accepted which suggests no difference angle-wise in lower lip length.

Table 9 shows the results of ANOVA test among the types forchin height.

Here P value is 0.016198 which is more than 0.05. Hence, null hypothesis is rejected which suggests there is difference angle-wise in chin height.

Table 10 shows the results of ANOVA test among the types for smile width.

Here P value is 0.061028 which is more than 0.05. Hence, null hypothesis is rejected which suggests there is difference angle-wise in smile width.

Table 11 shows the results of ANOVA test among the types for incisor display.

Here P value is 0.459272 which is more than 0.05. Hence, null hypothesis is accepted which suggests no difference angle-wise in incisor display.

Table 12 shows the results of ANOVA test among the types for buccal corridors.

Here P value is 0.205539 which is more than 0.05. Hence, null hypothesis is accepted which suggests no difference angle-wise in buccal corridors.

Table 13 shows the results of ANOVA test among the types for gingival display.

Here P value is 0.000531 which is more than 0.05. Hence, null hypothesis is rejected which suggests there is difference angle-wise in gingival display.

5. Discussion

This study aimed to identify the smile characteristics of female adults with high angle, medium angle, and low angle skeletal types. Each female had a single full-face frontal photograph taken with a staged smile, which Ackerman et al. claim is the most repeatable smile.[11]

The amount of maxillary gingival show is the primary aspect of the smile that affects esthetics, according to Mack[12] and Peck et al.[13] According to research by Hulsey[14] and Mackley,[15] an appealing smile requires the upper lip to be at the same height as the maxillary central incisors' gingival margin. Furthermore, 2.1 mm of gingival display was reported to be the optimal amount for smile esthetics by Ker et al.[16] The gingival display measured in this study for females with high angles was 2.26 mm, which was found to be significantly greater than the gingival displays observed for females with medium angles and low angles, which were 0.57 mm and 0.44 mm, respectively. According to Chiche and Pinault's research,[17] 2-3 mm of visible gingiva may be deemed esthetically acceptable, despite the fact that they noted that the ideal amount of gingiva was approximately 1 mm.

Table 1: Descriptive analysis for high angle cases

Upper lip length		Upper lip thickness	Smile width	loswer facial height	lower lip thickness	lower lip length	chin height	incisor display	buccal corridors	gingival display
Mean	16.222	7.1913 33333	63.88	66.616	9.532	16.348	34.84	10.111 33333	7.956	2.26
Standard Error	0.51 1363	0.3846 27051	1.8895 80704	1.1228 07196	0.3066 42649	0.5003 30557	2.4050 58162	0.2744 55073	0.6736 33219	0.4995 45508
Median	15.87	6.62	68.7	65.77	9.11	16.01	32.07	10	7.44	2.03
Mode	15.92	6.62	70.35	62.53	9.11	13.48	50.23	11.25	7.44	0
Standard Deviation	1.98 0498	1.4896 54162	7.3183 14599	4.3486 13572	1.1876 21873	1.9377 71916	9.3147 50208	1.0629 59928	2.608 97024	1.9347 31432
Sample Variance	3.92 2374	2.2190 69524	53.557 72857	18.9 1044	1.4104 45714	3.75 496	86.764 57143	1.129 88381	6.8067 25714	3.7431 85714
Range	6.7	5.76	21.63	14.3	4.12	6.06	28.54	3.81	8.32	5.64
Minimum	13.47	4.76	50.13	60.59	7.55	13.48	21.69	8.16	4.11	0
Maximum	20.17	10.52	71.76	74.89	11.67	19.54	50.23	11.97	12.43	5.64

Table 2: Descriptive analysis for medium angle cases

Upper lip length		Upper lip thickness	Smile width	Lower facial height,	lower lip thickness	Lower Lip length	Chin height	Incisor display	Buccal corridors	Gingival display
Mean	16.8 8867	7.4253 33333	63.992 66667	68. 04133333	9.7613 33333	15.6473 3333	27.2813 3333	9.41466 6667	7.2946 66667	0.57066 6667
Standard Error	1.00 0135	0.3865 60987	2.6774 36312	2.7277 66724	0.4434 59202	0.4903 4824	1.5588 62487	0.4605 95749	0.6400 4603	0.1944 62548
Median	17.09	7.25	62.32	64.94	9.62	15.2	25.87	9.97	7.74	0.3
Mode	#N/A	#N/A	#N/A	#N/A	10.26	#N/A	#N/A	#N/A	#N/A	0
Standard Deviation	3.873505	1.4971 44266	10.3696 6625	10.564 5951	1.7175 10103	1.8991 10569	6.0374 48452	1.7838 79667	2.4788 87615	0.753 15021
Sample Variance	15.00 404	2.2414 40952	107.529 9781	111.61 06695	2.9498 40952	3.6066 20952	36.450 78381	3.1822 26667	6.144 88381	0.567 235238
Range	14.55	5.83	41.05	35.33	6.92	6.96	21.26	5.82	7.52	2.27
Minimum	11.95	4.1	48.26	54.83	6.04	13.1	19.18	6.02	3.62	0
Maximum	26.5	9.93	89.31	90.16	12.96	20.06	40.44	11.84	11.14	2.27

Table 3: Descriptive analysis for low angle cases

Upper lip length		Upper lip thickness	Smile width	Lower facial height,	lower lip thickness	Lower Lip length	Chin height	Incisor display	Buccal corridors	Gingival display
Mean	16.728	6.7013 33333	71.038	68.395 33333	9.4006 66667	16.587 33333	28.794	9.3806 66667	8.9093 33333	0.4473 33333
Standard Error	0.83 5408	0.4751 08876	2.4748 46258	2.4731 69909	0.632 8375	0.7354 50925	1.5231 36426	0.5967 63067	0.5826 42148	0.2277 93697
Median	16.59	6.03	69.27	69.61	9.1	16.84	28.98	9.88	8.27	0
Mode	18.23	5.91	#N/A	#N/A	#N/A	18.26	28.98	12.09	#N/A	0
Standard Deviation	3.235 522	1.8400 88766	9.5850 38341	9.5785 45868	2.4509 69099	2.8483 89186	5.8990 82011	2.3112 53422	2.2565 63337	0.882 241194
Sample Variance	10.4686	3.3859 26667	91.8 7296	91.748 54095	6.0072 49524	8.1133 20952	34.799 16857	5.341 892381	5.092 078095	0.7783 49524
Range	13.22	7.15	34	37.25	9.09	11.51	21.4	7.07	6.67	3.04
Minimum	10.37	5.03	56.91	50.13	4.01	8.46	20.11	5.02	5.86	0
Maximum	23.59	12.18	90.91	87.38	13.1	19.97	41.51	12.09	12.53	3.04

Table 4: ANOVA for Upper lip length

Groups	Count	Sum	Average	Variance
Column 1	15	243.33	16.222	3.922374
Column 2	15	253.33	16.88866667	15.00404
Column 3	15	250.92	16.728	10.4686

Table 5: ANOVA for Upper lip thickness

Groups	Count	Sum	Average	Variance
high	15	107.87	7.191333	2.21907
medium	15	111.38	7.425333	2.241441
low	15	100.52	6.701333	3.385927

Table 6: ANOVA for Lower facial height

Groups	Count	Sum	Average	Variance
high	15	999.24	66.616	18.91044
medium	15	1020.62	68.04133	111.6107
low	15	1025.93	68.39533	91.74854

Table 7: ANOVA for Lower lip thickness

Groups	Count	Sum	Average	Variance
high	15	142.98	9.532	1.410446
medium	15	146.42	9.761333	2.949841
low	15	141.01	9.400667	6.00725

Table 8: ANOVA for Lower lip length

Groups	Count	Sum	Average	Variance
high	15	245.22	16.348	3.75496
medium	15	234.71	15.64733	3.606621
low	15	248.81	16.58733	8.113321

Table 9: ANOVA for Chin height

Groups	Count	Sum	Average	Variance
high	15	522.6	34.84	86.76457
medium	15	409.22	27.28133	36.45078
low	15	431.91	28.794	34.79917

Table 10: ANOVA for smile width

Groups	Count	Sum	Average	Variance
high	15	958.2	63.88	53.55773
medium	15	959.89	63.99267	107.53
low	15	1065.57	71.038	91.87296

Table 11: ANOVA for Incisor display

Groups	Count	Sum	Average	Variance
high	15	151.67	10.11133	1.129884
medium	15	141.22	9.414667	3.182227
low	15	140.71	9.380667	5.341892

Table 12: ANOVA for buccal corridors

Groups	Count	Sum	Average	Variance
high	15	119.34	7.956	6.806726
medium	15	109.42	7.294667	6.144884
low	15	133.64	8.909333	5.092078

Table 13: ANOVA for gingival display

Groups	Count	Sum	Average	Variance
High	15	33.9	2.26	3.743186
Medium	15	8.56	0.570667	0.567235
Low	15	6.71	0.447333	0.77835

In this study, gingival display was seen to be 2.26 mm in high angle, 0.57 mm in medium angle and 0.44 mm in low angle types. According to Nouh,[2] the gingival display was seen to be 3.20 mm. Here, the P-value was 0.0005 showing a significant difference among the types. Thus, proving that females with high mandibular angle show more of a gingival display compared to medium and low-angle types.

In this study, upper lip length was seen to be around 16 mm in all three types of females. The P-value was seen 0.83 which was seen non-significant among the types. According to Nouh[2] the upper lip length was seen to be 19.72 mm; and in the study by Nabawi,[1] it was 23.94 mm. In this study, the values were less than in the previous studies.

In this study, upper lip thickness was seen to be 7.1 mm in high angle, 7.42 mm in medium angle and 6.70 mm in low angle types. Here, the P-value was 0.46 showing no significant difference among the types. According to Nouh[2] the upper lip thickness was seen to be 6.29 mm, similar to this study. Nabawi[1] found it to be 10.08 mm. According to Mcintyre et al.[18] it was around 14.56 mm which suggests patients have thicker lips. This difference may be due to the different ethnicity of the study populations.

In this study, lower facial height was seen to be 66.61 mm in high angle, 68.04 mm in medium angle and 68.39 mm in low angle types. Here, the P-value was 0.83 showing no significant difference among the types. According to Nouh[2] the lower facial height was seen to be 61.65 mm. Nabawi[1] suggested the lower facial height to be 75.41 mm in his study, which is quite high compare to this study.

In this study, lower lip length was seen to be 16.348 mm in high angle, 15.64 mm in medium angle and 16.58 mm in low angle types. Here, the P-value was 0.50 showing no significant difference among the types. According to Nouh[2] the lower lip length was seen to be 23.9 mm.

In this study, lower lip thickness was seen to be 9.53 mm in high angle, 9.76 mm in medium angle and 9.40 mm in low angle types. Here, the P-value was 0.86 showing no significant difference among the types. According to Nouh[2] the lower lip thickness was seen to be 16.20 mm. This shows that, in this study, the patients showed to have thin lips.

In this study, chin height was seen to be 34.84 mm in high angle, 27.28 mm in medium angle and 28.7 mm in low angle types. Here, the P-value was 0.01 showing a significant difference among the types. This means that females with a high mandibular angle have longer chin height compared to medium and low-angle females. According to Nouh[2] the chin height was seen to be 37.09 mm, which was seen to be similar to that in this study.

In this study, smile width was seen to be 63.88 mm in high angle, 63.99 mm in medium angle and 71.08 mm in low angle types. Here, the P-value was 0.061 showing a significant difference among the types. This signifies that the females with low mandibular angle have a wider smile compared to high and medium angle females. According to Nouh[2] the smile width was seen to be 68.68 mm. This was similar to the smile width of females with low mandibular angle in our study. Thus, it can also be said that most of the patients have a horizontal to average growth pattern. The findings of Grover et al.[19] and Malhotra et al.[20] for Class I females showed maximum smile width being 66 mm. But in the study by Nabawi[1] it was around 76.77 mm, which is greater than other studies.

In this study, incisor display was seen to be 10.11 mm in high angle, 9.41 mm in medium angle and 9.38 mm in low angle types. Here, the P-value was 0.49 showing no significant difference among the types. According to Nouh,[2] the incisor display was seen to be 9.67 mm.

In this study, buccal corridors were seen to be 7.95 mm in high angle, 7.29 mm in medium angle and 8.90 mm in low angle types. Here, the P-value was 0.20 showing no significant difference among the types. According to Nouh,[2] the buccal corridors was seen to be 8.99 mm. According to Nabawi,[1] it was 7.87 mm, thus the results of this study are in accordance with the previous studies. But, Rashed and Heravi[21] pointed out that there were no differences in the buccal corridors among different malocclusion groups. Moreover, these results were similar to the results of McNamara et al.[22] and Krishnan et al.[23]

6. Conclusion

This concludes that;

1. Females with a high mandibular angle tend to have more gingival display when compared to the other two types. Even though it was within the normal limits.
2. Females with high mandibular angle were seen to have a longer chin when compared to the other two types.
3. Female with low mandibular angle tend to have broader smiles compared to the other types.
4. The other parameters showed similar results, thus there were no significant difference among these skeletal types.

7. Source of Funding

None.

8. Conflict of Interest

None.

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Cite this article: Raval RV, Mehta U, Sharma P, Patel K. An evaluation and comparison of smile characteristics of female adults in high angle, medium angle and low angle skeletal types – An observational study. *J Contemp Orthod* 2024;8(1):29-35.