RESEARCH PAPER

Evaluation of Smile Characteristic of Attractive Smile in Various Growth Pattern in Local Population

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ABSTRACT

Background: Smile attractiveness is influenced by dental, skeletal, and soft-tissue features, as well as individual perception. This study evaluated smile characteristics across different craniofacial growth patterns and compared attractiveness ratings provided by dental professionals and laypersons.

Methods: This observational study included 85 participants aged 16–30 years attending an orthodontic department in Udaipur, Rajasthan. Standardized frontal photographs were obtained at rest and during a posed smile. Two orthodontists, two prosthodontists, and two laypersons independently rated smile attractiveness using a five-point scale. Thirty participants with a final score of ≥3.5 underwent detailed evaluation and were classified into average, vertical, or horizontal growth-pattern groups. Lip and smile measurements were obtained from calibrated photographs using Adobe Photoshop. Groups were compared using one-way analysis of variance, Tukey's post hoc test, and Pearson's chi-square test.

Results: Among 510 ratings, score 3 was most frequent overall (39.8%) and within each assessor group. Upper lip length at rest differed significantly among the three growth patterns ($F=3.761$, $p=0.036$). It was greater in the vertical group than in the horizontal group (mean difference: 2.243 mm; 95% CI: 0.003–4.484; adjusted $p=0.050$). No significant group differences were found for the other parameters measured at rest or during smiling. A consonant smile arc was present in 66.7% of participants, but its distribution was not associated with growth pattern ($p=0.727$).

Conclusion: Most smile characteristics were similar across growth patterns. Smile assessment should combine objective measurements with individual aesthetic preferences.

Keywords: Craniofacial growth pattern; smile aesthetics; smile arc; lip length; orthodontics; facial photography.

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.INTRODUCTION

Physical attractiveness plays an important role in social interaction, self-confidence, and quality of life. Among facial expressions, the smile is one of the most noticeable features and is commonly associated with happiness, warmth, and approachability. A pleasing smile may positively influence social and professional interactions. Consequently, improvement in facial and smile aesthetics is one of the primary reasons individuals seek orthodontic treatment.[1]

The perception of an attractive smile is subjective and may vary according to personal experience, cultural background, and social environment. Opinions regarding smile attractiveness may also differ among orthodontists, general dentists, and laypersons. Smile appearance results from the complex interaction of dental, skeletal, and soft-tissue components during facial movement. Therefore, evaluation of the smile should consider both static facial features and its dynamic characteristics.[2]

Several parameters contribute to smile aesthetics, including upper and lower lip length, lip thickness, intercommissural width, buccal corridor, maxillary incisor display, interlabial gap, intervermillion distance, and smile arc.[3] The buccal corridor represents the dark space visible between the posterior teeth and corners of the mouth during smiling, while maxillary incisor display indicates the amount of upper anterior teeth visible. The smile arc describes the relationship between the curvature of the maxillary incisal edges and the contour of the

lower lip. A consonant smile arc is generally considered more attractive than a flat or reverse arc.[4] Craniofacial growth pattern may also influence smile characteristics. Individuals are commonly classified as having average, horizontal, or vertical growth patterns. Vertical growers may show greater gingival and incisor display, whereas horizontal growers may demonstrate broader smiles and reduced gingival exposure.[5] Evaluating these variations in the local population may improve diagnosis and help orthodontists develop individualized treatment plans that achieve balanced facial and smile aesthetics.

MATERIALS AND METHODS

This observational study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics, Pacific Dental College and Research Centre, Udaipur, Rajasthan. The study included 85 individuals from the local population who visited the department during the study period.

Participants aged 16–30 years with complete permanent dentition and good periodontal health were considered eligible. Individuals with a history of orthodontic treatment, maxillofacial surgery, or dentofacial trauma were excluded. Other exclusion criteria included gross facial asymmetry, excessive dental attrition, visible dental caries or periodontal disease, abnormalities or previous surgery of the lips, and missing or supernumerary teeth visible during smiling. Participants with prosthodontic or restorative work involving teeth visible in the smile were also excluded.

Standardized facial photographs were obtained using a Canon EOS 80D digital single-lens reflex camera fitted with a Canon EF 100-mm macro lens. The camera was mounted on a tripod and positioned 9 feet from the participant. Each participant wore spectacles fitted with a millimetre scale to permit photographic calibration. Two frontal photographs were recorded: one with the lips in a relaxed position and another displaying a natural, unstrained posed smile at the widest commissure-to-commissure position. Images were saved in JPEG format. **(Figure 1)**

The smiling photographs were displayed to a panel comprising two orthodontists, two prosthodontists, and two laypersons. Each assessor independently rated smile attractiveness on a five-point scale ranging from 1 (extremely disharmonious) to 5 (very attractive). The scores provided by the assessors were combined, and participants with a final attractiveness score of at least 3.5 were selected for further evaluation.

The selected participants were classified by an orthodontist into average, horizontal, and vertical growth-pattern groups using the clinical Frankfort–mandibular plane angle. Tangents to the Frankfort horizontal plane and lower border of the mandible were visualized clinically. An intersection beyond the occiput indicated a horizontal pattern, an intersection near the occiput indicated an average pattern, and an intersection anterior to the occiput indicated a vertical pattern. This clinical method avoided additional radiation exposure from cephalographic examination.

The photographs were imported into Adobe Photoshop and cropped to a standardized 6 × 4-inch perioral image. Measurements were calibrated using the 10-mm scale visible in each photograph. The ruler tool was then used to obtain measurements in millimetres.

Upper and lower lip lengths were recorded in the resting photographs. The smiling photographs were used to measure upper and lower lip length, upper and lower lip thickness, maxillary incisor display, interlabial gap, outer intercommissural width, buccal corridor space, intervermillion distance at the midline, and smile arc. All measurements were recorded in a structured data sheet and analysed using appropriate statistical methods. Continuous variables were summarized as mean and standard deviation and compared among the average, vertical, and horizontal growth-pattern groups using one-way analysis of variance (ANOVA). When the overall ANOVA was significant, Tukey's post hoc test was used for pairwise comparisons. Categorical variables were expressed as frequencies and percentages and compared using Pearson's chi-square test. A p-value <0.05 was considered statistically significant.

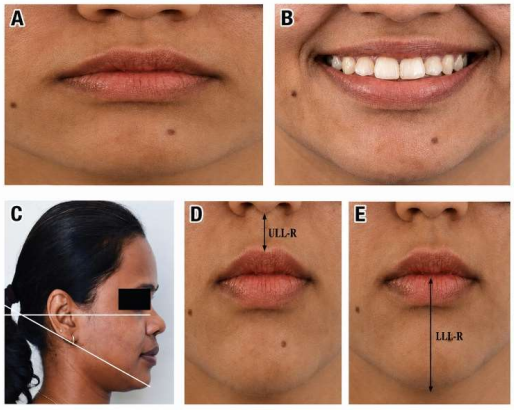

Figure 1. Standardized photographic assessment of smile characteristics and craniofacial growth pattern. (A) Participant at rest. (B) Participant displaying a natural posed smile. (C) Determination of craniofacial growth pattern using the clinical Frankfort–mandibular plane angle (FMA). (D) Measurement of upper lip length at rest (ULL-R). (E) Measurement of lower lip length at rest (LLL-R).

RESULTS

A total of 510 smile-attractiveness ratings were provided, with 170 ratings from each assessor group. An acceptable rating (score 3) was most common overall, accounting for 203 (39.8%) ratings. It was also the most frequent rating among orthodontists (39.4%), prosthodontists (45.3%), and laypersons

(34.7%). A disharmonious rating (score 2) accounted for 27.3% of all ratings, while 19.8% were rated as attractive. Laypersons assigned the extremely disharmonious rating more frequently (12.9%) than orthodontists (6.5%) and prosthodontists (5.3%). The very attractive rating was least frequently assigned overall (4.9%) and was particularly uncommon among prosthodontists (1.8%). **(Table 1)**

At rest, upper lip length differed significantly among the average, vertical, and horizontal growth-pattern groups (F=3.761, p=0.036), whereas lower lip length showed no significant difference (F=1.038, p=0.368). During smiling, no significant differences were observed among the three growth patterns for upper lip length, lower lip length, upper lip thickness, lower lip thickness, maxillary incisor display, interlabial gap, intercommissural width, buccal corridor, or intervermillion distance (all p>0.05). Tukey-adjusted analysis showed that upper lip length at rest was greater in the vertical group than in the horizontal group, with a mean difference of 2.243 mm (95% CI: 0.003–4.484; adjusted p=0.050). No other pairwise comparison was statistically significant. **(Table 2)**

A consonant smile arc was observed in 20 (66.7%) participants, while 10 (33.3%) exhibited a flat smile arc. The consonant arc was the predominant pattern in all three growth groups and was most frequent among participants with an average growth pattern (75.0%). It was observed in 62.5% of participants with a horizontal pattern and 60.0% of those with a vertical pattern. Flat smile arcs were comparatively more frequent in the vertical group (40.0%), followed by the horizontal (37.5%) and average (25.0%) groups. However, smile-arc distribution was not significantly associated with craniofacial growth pattern (Pearson's χ^2=0.638, df=2, p=0.727). **(Table 3)**

Table 1. Distribution of smile-attractiveness ratings according to assessor group

Rating	Orthodontists n (%)	Prosthodontists n (%)	Laypersons n (%)	Overall n (%)
1 – Extremely disharmonious	11 (6.5)	9 (5.3)	22 (12.9)	42 (8.2)
2 – Disharmonious	51 (30.0)	47 (27.6)	41 (24.1)	139 (27.3)
3 – Acceptable	67 (39.4)	77 (45.3)	59 (34.7)	203 (39.8)
4 – Attractive	30 (17.6)	34 (20.0)	37 (21.8)	101 (19.8)
5 – Very attractive	11 (6.5)	3 (1.8)	11 (6.5)	25 (4.9)
Total ratings	**170 (100.0)**	**170 (100.0)**	**170 (100.0)**	**510 (100.0)**

Table 2. Comparison of lip and smile parameters among craniofacial growth patterns

Measurement	F-value	p-value
At rest		
Upper lip length(mm)	3.761	**0.036**
Lower lip length(mm)	1.038	0.368
During smiling		
Upper lip length(mm)	2.034	0.150
Lower lip length(mm)	0.618	0.546
Upper lip thickness(mm)	0.177	0.839
Lower lip thickness(mm)	0.507	0.608
Maxillary incisor display(mm)	0.566	0.575
Interlabial gap(mm)	0.045	0.956
Intercommissural width(mm)	0.542	0.588
Buccal corridor(mm)	0.003	0.997
Intervermillion distance(mm)	0.218	0.806
On Tukey-adjusted pairwise analysis, upper lip length was greater in the vertical group than in the horizontal group (mean difference: 2.243 mm; 95% CI: 0.003–4.484; adjusted p=0.050). No other pairwise difference was significant.		

Table 3. Distribution of smile-arc patterns according to craniofacial growth pattern

Growth pattern	Consonant arc	Flat arc	Total n (%)

	n (%)	n (%)	
Average	9 (75.0)	3 (25.0)	12 (100.0)
Vertical	6 (60.0)	4 (40.0)	10 (100.0)
Horizontal	5 (62.5)	3 (37.5)	8 (100.0)
Overall	**20 (66.7)**	**10 (33.3)**	**30 (100.0)**
Pearson's χ^2=0.638, df=2, p=0.727.			

DISCUSSION

Smile aesthetics is an important component of facial attractiveness and orthodontic treatment planning. The present study examined differences in smile perception among orthodontists, prosthodontists, and laypersons and evaluated smile characteristics across average, vertical, and horizontal craniofacial growth patterns. A rating of 3 was most frequently assigned by all three assessor groups. Orthodontists and prosthodontists generally concentrated their ratings around the middle of the scale, whereas laypersons showed greater variation and assigned more extreme scores. Similar differences were reported by Vinod Krishnan et al. and Divyaroop Rai et al., who observed that professional assessment was generally more consistent, while layperson ratings were influenced by individual preferences.[2,6] Dental professionals may assess smiles critically because of their knowledge of tooth position, gingival display, lip form, and facial proportions. Sawsan A. Alomari et al. also found differences between professional and lay perceptions of smile attractiveness.[7] Nevertheless, the variation among individual assessors in the present study shows that professional training does not completely remove subjectivity. This agrees with Brian J. Schabel et al., who reported considerable variation in subjective smile assessment and suggested that objective measurements alone cannot fully predict attractiveness.[8]

Most parameters measured during smiling, including upper and lower lip length, lip thickness, maxillary incisor display, interlabial gap, intercommissural width, buccal corridor, and intervermillion distance, did not differ significantly among the three growth patterns. These findings suggest that craniofacial growth pattern alone may not determine smile appearance. They differ from the observations of Neha Grover et al., Akiladevi Senthilkumar et al., and Richa Ahlawat et al., who reported variations in smile characteristics among growth patterns.[1,5,9] Differences in sample size, population characteristics, classification methods, and photographic procedures may explain the inconsistent findings.

Upper lip length at rest was the only continuous parameter showing a significant overall difference. Tukey analysis indicated a borderline significant difference between the vertical and horizontal groups, with greater upper lip length in the vertical group. No pairwise differences were found for lower lip length. These findings indicate that resting soft-tissue morphology may show some relationship with skeletal growth direction, although the small observed difference should be interpreted cautiously. Guilherme Janson et al. similarly suggested that isolated smile features may have limited influence on overall smile attractiveness.[10]

A consonant smile arc was present in 66.7% of participants and was the predominant type in every growth group. However, smile-arc distribution was not significantly associated with growth pattern. This differs from findings reported by Anisha Janu et al. and Akiladevi Senthilkumar et al., who identified smile arc as an important aesthetic feature.[1,11] Buccal corridor measurements also showed no significant group difference, despite their reported aesthetic relevance in studies by Adam J. Martin et al., Hyung Yang et al., and Divyaroop Rai et al..[6,12,13]

These findings support combining objective measurements with patient preferences during treatment planning. The study was limited by its small final sample, single-centre design, posed photographs, clinical growth-pattern classification, and possible cultural variation in aesthetic perception. Future multicentre studies should use larger samples, cephalometric confirmation, examiner-reliability testing, and dynamic video-based smile analysis.

CONCLUSION

Smile perception varied among orthodontists, prosthodontists, and laypersons, with professionals generally providing more consistent ratings. Most smile parameters measured during smiling did not differ significantly among average, vertical, and horizontal growth patterns. Upper lip length at rest showed a significant overall difference, with a borderline difference between vertical and horizontal patterns. Smile arc and buccal corridor were not associated with growth pattern. These findings indicate that smile attractiveness is multifactorial and should be evaluated using objective measurements together with individual patient preferences.

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