

Evaluation of Different Parameters Responsible for Perception of a Pleasing Profile - A Photographic Silhouette Study from Vadodara, India

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ABSTRACT

BACKGROUND

Orthodontics has witnessed a paradigm shift in the perception of aesthetics. Soft tissue assessment and correction has become a greater concern when compared with dental and skeletal correction. In the current era, pleasing profile is a prime requisite. The purpose of this study is to evaluate different parameters responsible for perception of a pleasing profile.

METHODS

Hundred dental students with well-balanced faces were selected. Profile photographs of participants were taken by DSLR camera maintaining standardized photography protocol. The principal investigator had measured ten soft tissue parameters for each profile photograph. These profile photographs were further converted into profile silhouettes. 10 laypersons appraised each profile silhouette using visual analog scale (VAS). The obtained scores were again correlated with photographic measurements of each individual to identify role of different parameters responsible for pleasing profile.

RESULTS

When comparing the data statistically, significant differences were found amongst the parameters between less attractive and more attractive profile; parameters include facial convexity angle, naso-labial angle, protrusion of lip relative to each other, vertical lip to chin ratio and vertical height ratio.

CONCLUSIONS

It was clear from this study that, amongst individuals with normal overjet, overbite and a pleasing profile, those subjects with more obtuse facial convexity angle, obtuse nasolabial angle, slightly more protruded upper lip than lower lip, equivalent vertical height ratio, and smaller lip-chin ratio vertically, were found to be more attractive, as perceived by laypersons.

KEY WORDS

Parameters, Photographic Soft Tissue Analysis, Silhouette Study, Pleasing Profile

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BACKGROUND

Facial aesthetics has been an area of interest for people of varied culture since a long time.¹ The primary aims of a successful orthodontic treatment are improved function, better and socially acceptable aesthetics and treatment stability. However, now a days, aesthetics has become the chief reason for people seeking orthodontic treatment.² A patient majorly judges the final outcome of his or her orthodontic treatment by judging the improvement in facial appearance.³ The facial outline by the end of an orthodontic treatment serves as an important guideline for treatment planning because of the binding relation between facial aesthetics and the orthodontic treatment.^{4,5} According to Lew, major motivational reasons for people undergoing orthodontic treatment were - an overall improvement of dentofacial appearance and a boost in the self-confidence post treatment.

Although the existing literature is replete with studies on cephalometric norms for facial attractiveness, they might not be the same for the profile attractiveness of an individual. These cephalometric norms might be more relevant to orthodontic treatment by orthognathic or plastic surgeries. Analysis of soft tissue during orthodontic diagnosis and treatment planning should be considered for accurate evaluation of any underlying skeletal defect due to individual differences in the thickness of soft tissues and their morphology. Therefore, it is of utmost importance to identify the factors associated with the aesthetics of soft-tissue profile.⁷

The perception of an attractive face is largely subjective, with ethnicity, age, gender, culture and personality because all these factors influence the average facial traits significantly. Czarnecki et al.⁸ (1993) evaluated the perception of facial balance and found that the factors most influencing the same were varying lengths of the nose, amount of protrusion of lips, and the development of the chin. They concluded that these interrelationships of different facial features have to be in balance in order to achieve an aesthetically pleasing facial harmony.

The prescribed standards might represent the normal or average facial patterns. But they do not identify the best or most attractive profile from among a given population. Aesthetic corrections need to be carried out keeping in mind the factors that affects the facial attractiveness and the extent of modifications that are required. Therefore, establishing the measurements of attractive subjects as standard norms and evaluation of the variables that contribute to the attractiveness of a facial profile has significant clinical implications.

For aesthetic analysis, some researchers believe in using silhouettes instead of profile photographs. This method eliminates unnecessary distractions so that the focus is on the patient's profile entirely.⁹ Michiels¹⁰ suggests the inadequacy of cephalometric analyses in diagnosis and treatment planning. When cranial base is used as reference to evaluate the facial profile, the landmarks used are sometimes inaccurate in the evaluation of the actual clinical profile. Photographic evaluation is rather an accurate representation of the facial appearance. It is superior when compared to cephalogram which gives only the facial outline. Therefore,

it is necessary to supplement the cephalometric analysis with photographic evaluation during orthodontic diagnosis and treatment planning.

Professional opinions regarding evaluation of facial aesthetics need not necessarily be the same as that of lay persons. The need of the hour is to evaluate the perception of attractive faces by the laypersons. Therefore, this study attempts to identify the profile features that contribute majorly to facial attractiveness from a layperson's perspective. The factors thus identified can be used to achieve an attractive facial profile by means of orthodontic treatment. These would serve as guides for aesthetic treatment goals.

Objectives

1. To evaluate parameters responsible for perception of a pleasing profile by laypersons.
2. To evaluate the role of different parameters responsible for perception of a pleasing profile by laypersons.

METHODS

This is a cross-sectional study conducted on students of K.M. Shah Dental College and Hospital, Sumandeep Vidyapeeth at the Department of Orthodontics and Dentofacial Orthopaedics, K.M. Shah Dental College and Hospital, Sumandeep Vidyapeeth from February 2020 to July 2020. Ethical approval was obtained by Sumandeep Vidyapeeth Institutional Ethical committee (SVIEC).

Sample Description

Participants 1 (for Photographic Records)

The sample size has been estimated, following pilot study assessment of inclusion criteria (Normal overjet and overbite, well aligned anteriors and pleasing profile) among the eligible subjects by formula;

$$= \frac{(Z\alpha + Z\beta) 2 \times 2p(1-p)}{d^2}$$

- $Z\alpha$ is value of Z for $\alpha = 0.05$ (95 % confidence interval)
- $Z\beta$ is value of Z, when power of study is assumed to be 80 %
- P is the proportion of subjects eligible for the study according to inclusion criteria in the population (obtained from pilot study sample - 44 %)

$$= \frac{(1.96 + 0.84)2 \times 2 \times 0.44(1 - 0.44)}{0.04}$$

$$= 3.86 / 0.04$$

$$= 96.58$$

$$= 97$$

The total number of 100 participants were taken to eliminate dropout ratio.

Participant 2 (as Evaluators)

Evaluators sample size is based on the previous study done by Fataneh Ghorbanyjadpour and Vahid

Rakhshanb.⁷ Total 10 layperson will be taken for evaluating profile silhouettes according to base article.

Sample Selection

Participant 1 (for photographic records)

Inclusion Criteria

- Age; 18 to 25 Years
- Well aligned incisors
- All permanent teeth should be present apart from third molars
- Normal overjet and overbite
- Pleasing Profile

Exclusion Criteria

- History of previous orthodontic treatment
- Congenital anomalies/defects
- Facial asymmetry/disharmony
- Periodontal disease
- Facial muscular imbalances
- History of facial trauma and or any orthognathic surgical procedure

Inclusion Criteria for Evaluators

- Age of the evaluator should be above 18 years.

Exclusion Criteria for Evaluators

- Evaluator should not be mentally challenged
- With impaired eyesight.

Conventional Photography Method

A standardized profile photograph was obtained in the photographic area of the department under quality lighting. The participant was made to sit erect on a stool. The position of camera was fixed on a tripod and positioned such that the distance between camera lens and the subject was 36 inches. Photographic umbrella was utilised for adequate illumination. The photographs were taken using Canon EOS 200 D DSLR with 18 - 55 macro lens having 24.2 megapixels, CMOS type image sensor having a size of 22.3 x 14.9 mm with maximum output resolution of 6000 x 4000.

All the images were portrait mode without zoom with fixing of ruler behind the subject vertically for image calibration. Natural head position of participants was recognized by making them wear glasses having fluid level device as introduced by Showfety¹¹ et al. All the standardized photographs captured have been transferred to the computer software

Principal investigator had done all the measurements by doing photographic analysis^{12,13} using landmarks glabella (G), soft tissue Nasion (N'), Pronasale (Pn), Columella (Cm), Subnasale (Sn), Labrale superius (Ls), Labrale inferius (Li), Stomion superius (STMs), Stomion inferius (STMi), soft tissue pogonion (Pg'), soft tissue B point (B'), soft tissue menton (Me') and cervical point (C),

Frankfort horizontal plane (FH). (All landmarks on photographs)

Angular Measurements (in) Comprised of

1. G - Sn - Pg' (facial convexity angle)
2. G - N' - Pn (frontonasal angle)
3. Cm - Sn - Ls (nasolabial angle)

Linear Measurements (mm) are

1. Ls to (Sn - Pg') (protrusion of upper lip)
2. Li to (Sn - Pg') (protrusion of lower lip)
3. Si to (Li - Pg') (mentolabial sulcus)

Relative Measurements are

1. G - Sn / Sn - Me' (ratio of vertical height)
2. Sn - Gn' / C - Gn' (lower vertical height- depth ratio)
3. Sn - Stms / Stmi - Me' (vertical lip- chin ratio)
4. Ls - Li (FH) (protrusion of upper lip relative to the lower lip position)

To minimize the distraction bias by facial features such as hair style and color, facial makeup, shape of eye and eyebrows, photographs were converted into soft-tissue silhouettes against a white background (Participant's silhouettes) (Adobe Photoshop Version 7.0.1).

A panel of 10 laypersons was made to observe and assess all 100 profile silhouettes.⁷ The layperson was randomly selected from the general public. PowerPoint presentation of silhouette was presented to referees without mentioning the subject's sex or age. Each judge was requested to rate all images twice in 2 sessions with 1 - week intervals.

In each session, each slide was evaluated as per the 10 cm (VAS) by each judge. The average of both sessions was calculated and assigned to each silhouette. The scores were given by 10 judges to each subject. Standardization of image was done using method given by Desai et al.¹⁵ The image ratio of 1 : 1 will be maintained for the calibration of all images.

Statistical Analysis

Errors for photographic analysis was assessed using the Dahlberg formula on randomly selected photographs. The errors ranged from 0.20 to 0.42 for angular measurements and from 0.10 to 0.18 for linear measurements. According to the Cronbach alpha, the intra-rater reliabilities for both variables were > = 99 % (P = 0.001). Pearson correlation coefficient along with an unpaired t test was used to check the bivariable associations between the more attractive and less attractive group. The level of statistical significance was set at 0.05.

RESULTS

The mean age of the subjects was 21.1 ± 3.2 years. Table I is showing average score given to each profile by 10 laypersons. The total number of females and males in less attractive group, average attractive group and more attractive group are respectively 33, 52 and 15 based on the scores given by the judges. Measurements of the soft

tissue parameters for the less attractive group and more attractive group are shown in Table 2 and Table 3 respectively.

Attractiveness	Score	No of Profile
Less attractive	0	0
	1	2
	2	8
	3	5
Average attractive	4	14
	5	10
	6	8
	7	20
More attractive	8	7
	9	15
	10	11

Table 1. Average Score Given to Each Profile by 10 Laypersons

Measurements	Mean	SD	Minimum	Maximum
G - Sn - Pg' (°)	160.05	6.58	153	170
G - N' - Pn (°)	132.66	8.23	123	144
Cm - Sn - Ls (°)	100.12	8.08	91	110
Ls to (Sn - Pg') (mm)	2.57	2.03	- 2	7.4
Li to (Sn - Pg') (mm)	2.3	2.82	- 3	4.8
Si to (Li - Pg') (mm)	4.6	1.01	3	6
G - Sn / Sn - Me'	0.75	0.11	0.6	1.2
Sn - Gn' / C - Gn'	1.33	0.5	0.9	1.9
Sn - Stms / Stmi - Me'	0.43	0.04	0.4	0.5
Ls - Li (TH) (mm)	- 0.13	1.68	- 2.4	2

Table 2. Soft Tissue Parameters of Less Attractive Profile (Score; 0 to 4) [n = 15]

Measurements	Mean	SD	Minimum	Maximum
G - Sn - Pg' (°)	163.33	2.3	160	166
G - N' - Pn (°)	138.28	4.7	131	147
Cm - Sn - Ls (°)	105.16	6.4	97	113
Ls to (Sn - Pg') (mm)	2.8	1.22	1	3.7
Li to (Sn - Pg') (mm)	2.1	0.80	1	3.1
Si to (Li - Pg') (mm)	4.3	1.05	2.8	5.9
G - Sn / Sn - Me'	0.98	0.03	0.85	1
Sn - Gn' / C - Gn'	1.26	0.06	1.15	1.4
Sn - Stms / Stmi - Me'	0.48	0.03	0.43	0.5
Ls - Li (TH) (mm)	0.87	0.74	0.2	1.7

Table 3. Soft Tissue Parameters of More Attractive Profile (Score; 8 - 10) [n = 33]

The measurements of the less attractive profile group were compared with the measurements of more attractive profile group.

There were significant differences found amongst the parameters which are responsible for attractiveness of any profile which include facial convexity angle, nasolabial angle, protrusion of upper lip relative to the lower lip position, vertical lip to chin ratio and vertical height ratio.

Measurements	More Attractive		Less Attractive		P Value
	Mean	SD	Mean	SD	
G - Sn - Pg' (°)	163.33	2.3	160.05	6.58	0.012*
G - N' - Pn (°)	138.28	4.7	132.66	8.23	0.062
Cm - Sn - Ls (°)	105.16	6.4	100.12	8.08	0.013*
Ls to (Sn - Pg') (mm)	2.8	1.22	2.57	2.03	0.568
Li to (Sn - Pg') (mm)	2.1	0.80	2.3	2.82	0.193
Si to (Li - Pg') (mm)	4.3	1.05	4.6	1.01	0.623
G - Sn / Sn - Me'	0.98	0.03	0.75	0.11	0.014*
Sn - Gn' / C - Gn'	1.26	0.06	1.33	0.5	0.145
Sn - Stms / Stmi - Me'	0.48	0.03	0.43	0.04	0.043*
Ls - Li (FH) (mm)	0.87	0.74	- 0.13	1.68	0.006*

Table 4. Comparison between Measurements of More Attractive and Less Attractive Profile

* - Clinically significant values

DISCUSSION

This study attempted to recognize parameters contributing to attractiveness of the profile. In this study, increased facial convexity angle (G - Sn - Pg') is more attractive. Laypersons found straight profiles as

significantly more pleasant. According to some authors, convex profiles with fuller lips may give younger look in women. In men, a straighter profile with less protruded lips might be more desirable.^{16,17} Research found that convex profile for German women and Turkish women with straight profile are more of desirable aesthetics. Profiles can be affected by culture, ethnicity and gender of judges.

In present study, more obtuse frontonasal angle (G - N' - Pn) was preferred by judges for a more attractive profile with less prominent nose. Obtuse nasolabial angle (Cm - Sn - Ls) pointing to a less prominent but higher nose tip, seems pleasant. In previous studies white American individuals with more obtuse angle; and Turkish people with results similar to the present study are found to be pleasing.¹⁸ In contrast, an acute nasolabial angle was important in Chinese population for attractiveness of profile.¹⁹

Lip prominence is strongly subjective by ethnicity and gender of both patients and judges. The present study indicated that position of upper and lower lip did not influence aesthetic, similar result conducted by Al - Gunaid.²⁰ But protrusion of upper lip relative to lower lip can. In this study, laypersons found those profiles attractive in which, the lower lip is about 0.5 to 0.7 mm retruded than the upper lip. Compared with African judges, referees from Hispanic - American or Japanese ethnic backgrounds preferred less protruded lips for attractive profile. For a male European - American, retruded lips may be more pleasant. For an African - American or a Japanese subject, prominent lips would be attractive. Still, many studies have shown that more appealing face has fuller lips with smaller noses.^{17,18}

Mentolabial sulcus indicates prominence of the chin and the lower lip which points toward incisor position. It has been shown that more prominent chin is found more attractive in present study.

More pleasant profile had smaller vertical lip to chin ratio found in the present study. Turkish and American females had smaller vertical lip to chin ratios, representative lips are closer to the nose in females.²⁰

Previous studies and present study approved that the vertical height ratio, middle and lower thirds are nearly equal (vertical height ratio = 1) for attractive profile. Vertical height ratio has implications in changing the occlusal vertical dimension and planning dentofacial surgery.¹⁸⁻²⁰

CONCLUSIONS

It was clear from this study that, amongst individuals with normal overjet, overbite and a pleasing profile, those subjects with more obtuse facial convexity angle, obtuse nasolabial angle, slightly more protruded upper lip than lower lip, almost equal vertical height ratio, and smaller vertical lip-chin ratio, were found to be more attractive, as perceived by laypersons.

However, some parameters like frontonasal angle, lip protrusion, mentolabial sulcus and lower vertical height-depth ratio did not play any significant role in determining

the attractiveness of a profile from a laypersons point of view.

Data sharing statement provided by the authors is available with the full text of this article at jemds.com.

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