

Assessment of objective and subjective measures as indicators for facial esthetics

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Abstract


Background: The study mentioned was aimed to examine the contribution of the objective measures representing anterior-posterior (AP) and vertical characteristics, dental esthetics, or their combination that are used in daily orthodontic practice in the assessment of the facial esthetics. **Materials and Methods:** A panel of 64 laypersons evaluated the facial esthetics of 32 boys and 32 girls, stratified over four different angle classes, on a visual analog scale. The relationship between the objective parameters and facial esthetics was evaluated by the backward multiple regression analysis. **Results:** Dental esthetics, expressed by the esthetic component of the index of orthodontic treatment need (AC/IOTN), appeared to be the most vital indicator for facial esthetics. The horizontal sum, a variable for AP characteristics of the patient, could be a better variable when compared with the overjet. **Conclusion:** Addition of this newly defined parameter to the AC/IOTN improved the prognostic value from 25% to 35%.

Key words: Anterior-posterior characteristics, dental esthetics, facial esthetics, vertical characteristics

Introduction

Concern regarding facial esthetics is one of the most probable reasons to seek orthodontic and/

or surgical orthodontic treatment.^[1] The dentition and the occlusal relationship play a vital role in determining

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the overall perception of facial esthetics.^[2] The degree of anteroposterior (AP) discrepancy, either dental or skeletal, often serves as an indicator of malocclusion, and by inference the need for the treatment. The treatment plan, orthodontics and/or orthognathic surgery, for patients with more severe problems is frequently dictated in part by esthetic concerns.^[3] Orthodontic patients and their parents believe that well-aligned teeth are important for an overall pleasing appearance. The decision to undergo orthodontic treatment seems to be motivated by social norms and the beauty culture in their reference group. Therefore, the opinion of the laymen is an important parameter in determining the success of orthodontic treatment.^[4] Orthodontists, however, prefer to use objective parameters instead of opinions for their diagnosis, treatment plan and evaluation of the outcome of their clinical intervention. Their treatment plans are often focused at changing these parameters to normality. The objective parameters used by the orthodontists usually include quantitative descriptions of AP, vertical discrepancies, and dental irregularities.^[5] Studies carried out to relate the laypersons perception of facial esthetics to the orthodontist's objective parameters of facial and dental value are scarce. It is postulated that laypeople will vary in their subjective viewpoints, and this would be dependent upon the environment that they are exposed to. Hence, this study was done to determine the objective parameters used in daily orthodontic practice related to facial esthetics, as perceived by the laypeople in the selected district. The objective parameters used represented AP characteristics (overjet and ANB angle), vertical characteristics (SN-GoGn angle), and dental esthetics esthetic component of the index of orthodontic treatment need (AC/IOTN). This study examined and correlated the contribution of the objective measures representing AP and vertical characteristics, dental esthetics, or their combination that are used in daily orthodontic practice with subjective measures in the assessment of facial esthetics for the test group population.

Materials and Methods

Inclusion criteria for subjects for the collection of data are as follows:

- The age is between 10 and 25 years
- Had no dental or facial trauma
- Had no history of orthodontic treatment
- Had no congenital defects
- Not been wearing glasses
- The panel of laypeople should be from different professional backgrounds.

About 64 patients were randomly selected after stratification, from the records of the Department of Orthodontics of a Dental Hospital. Eight boys and eight girls each, in angles Class I; Class II Division I; Class II Division II; Class III malocclusions, were shortlisted. The

objective parameters were obtained from the pretreatment records (dental casts, cephalograms, extraoral and intraoral color photographs) [Figures 1-3] of these patients. Subjective parameters: 64 laypeople (32 males and 32 females) were chosen from professional colleges in the area. Each subject was given a Performa having 64 patients' names and a visual analog scale (VAS) (A VAS, operationally, a measurement instrument with horizontal line, which is 100 mm in length, anchored by 0 in beginning and 100 at the end representing least attractiveness and most attractiveness parameters marked, respectively. The subject marks on the line, the point that they feel represents their perception of the variable under consideration. The VAS score is then determined by measuring the length of the line marked, in millimeters, from the left-hand end of the line to the point that the subject had marked against each patient. A slide show presenting the digital images in the (a) frontal view, (b) three-quarter smiling view, and (c) profile view of each patient was prepared. Each face was shown for 15 s [Figure 4].

Objective parameters

The following objective parameters were obtained from the records:

- Overjet was measured on the dental casts as the AP distance between the maxillary and mandibular central incisors at the most labial point of the most prominent incisor [Figure 1]
- ANB angle and SN-GoGn angle were measured on tracing of lateral head film [Figure 2]
- The horizontal sum obtained as the summation of the overjet in millimeters and ANB in degrees
- AC/IOTN was determined on intraoral pictures [Figure 5] by mutual agreement between two independent observers (as per the guidelines of Shaw WC).^[2]

After the collection of data on the varied objective and subjective criteria, the data were subjected to statistical analysis. The normality of the data was clarified by Kolmogorov-Smirnov Z test. Then, the data were analyzed by one-way analysis of variance (ANOVA) test to find out the significant difference between more than two groups followed by Tukeys multiple *post hoc* procedures for pairwise comparison. Further, the multiple linear regression was performed to see the influence of independent variables on the dependent variable. The statistical analysis was performed by using statistical software IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp. The statistical significance for One way ANOVA was set at 5% level of significance ($P < 0.05$).

Results

The values and standard deviations of the various objective parameters obtained and segregated into angle's classes [Table 1]. One-way ANOVA test done to compare



Figure 1: Overjet measurement using ruler



Figure 3: A sample of extraoral photographs of a patient

Table 1: The mean and standard deviation of different objective parameters obtained grouped according to Angle's classification

Variables	Class I	Class II Division I	Class II Division II	Class III	Average of the entire group
Over jet in mms	5.9±4	7.8±2.4	2±3	1±4.5	4±4.4
ANB (°)	5±3	5±3	4±2	-1±6	4±5
Horizontal sum ^[6] (over jet + ANB)	11±5	13±4	7±4	8±5	10±5
SN-GoGn (°)	31±4	30±6	27±7	31±7	30±6
IOTN in grades	7±2	4±2	5±1	5±3	5±2

IOTN: Index of orthodontic treatment need

various classes with respect to the different objective parameters indicated that all the parameters, except the vertical parameter (SN-GoGn; $P = 0.1758$, ($P > 0.05$) not significant), showed a statistically significant variation between different classes. Overjet, ANB, IOTN, and horizontal sum were significantly correlated with P value of 0.0000, 0.0001, 0.00400, and 0.0008, respectively [Table 2]. It was deduced that the value of each parameter was significantly different from the same parameter in other class. The esthetic scores (VAS scores) given by male and female reviewing laypeople were compared [Table 3]. It was observed that the comparison of different classes with respect to VAS scores given by male and female laypeople was found to be nonsignificant. Multiple regression analysis of the subjective parameter, the VAS scores (dependent

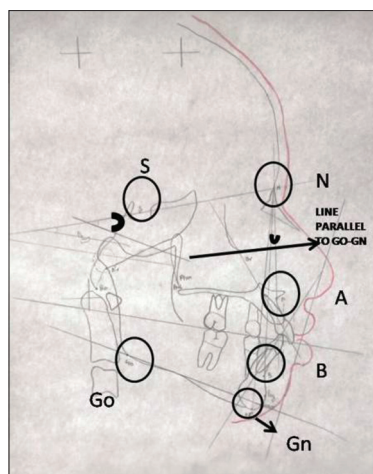


Figure 2: ANB and SN-GoGn sella-nasion-gonion gnathion measurement from lateral cephalogram



Figure 4: Sample of intraoral photographs of a patient

variable) with the objective parameters taken, indicated that though the overjet, horizontal sum, and AC (IOTN) negatively correlated with the objective parameters, only the AC (IOTN) showed a statistically significant negative correlation [Table 4]. A backward stepwise multiple regression analysis of VAS scores according to the total sample of laypersons showed a significant correlation between subjective VAS score with the AC (IOTN) [Table 5].

Discussion

The most commonly used parameter for AP characteristics is Angle classification, which is a rough estimate having four discrete classes.^[7] For proper orientation of the jaw, combination of ANB and overjet has been indicated.^[5] The effect of the vertical on facial attractiveness has been studied on constructed profiles or manipulated photographs.^[6,8] Most orthodontists use SN-GoGn angle for the evaluation of vertical dimensions in daily clinical practice, but the relation of this parameter to facial attractiveness has been debatable.^[4] The AC/IOTN have been widely used.^[9] Both orthodontists and laymen are well able to use VAS scores to judge facial esthetics from photographs in a more or less intuitive

Table 2: Comparison of classes with respect to different objective measurements by one-way ANOVA

Variable	Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F	P	Significance
Over jet	Between classes	3	488.9180	162.9727	13.6085	0.0000	S
	Within classes	60	718.5469	11.9758			
	Total	63	1207.4648				
ANB	Between classes	3	371.0000	123.6667	8.4631	0.0001	S
	Within classes	60	876.7500	14.6125			
	Total	63	1247.7500				
HS	Between classes	3	428.5430	142.8477	6.4127	0.0008	S
	Within classes	60	1336.5469	22.2758			
	Total	63	1765.0898				
SN-GoGn	Between classes	3	185.7969	61.9323	1.7038	0.1758	NS
	Within classes	60	2180.9375	36.3490			
	Total	63	2366.7344				
IOTN	Between classes	3	58.3750	19.4583	4.9340	0.0040	S
	Within classes	60	236.6250	3.9438			
	Total	63	295.0000				

NS: Not significant, S: Significant, IOTN: Index of orthodontic treatment need

Table 3: Comparison of the different angle's classes (I, II Division I, II Division II, III) with respect to visual analog scale scores given by male and female laypersons

Layperson	Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F	P	Significant
Male	Between classes	3	58.7604	19.5868	0.9313	0.4313	NS
	Within classes	60	1261.9652	21.0328			
	Total	63	1320.7256				
Female	Between classes	3	41.2886	13.7629	0.9002	0.4465	NS
	Within classes	60	917.3193	15.2887			
	Total	63	958.6079				

NS: Not significant

Table 4: Multiple regression analysis of visual analog scale scores according to the total laypersons (male and female laypersons) (dependent variable) with objective measurements (independent variables)

Input variables	Beta coefficient	SE of beta coefficient	Regression coefficient	SE of regression coefficient	t	P level	Significance
Intercept			75.0207	6.0664	24.8146	0.0000	S
Over jet	-0.1014	0.4320	-0.1135	0.4189	-0.4529	1.2803	NS
ANB	0.1304	0.2838	0.1243	0.2706	0.9196	1.2948	NS
Sn-GoGn	0.0228	0.2596	0.0115	0.1798	0.1826	1.5414	NS
IOTN	-0.3454	0.2622	-0.6420	0.5142	-2.5563	0.6742	S
HS	-0.2827	0.4573	-0.2234	0.3667	-1.2385	1.0812	NS

$R=0.4604$, $R^2=0.0778$, $F(5, 58)=0.8539$, $P>0.05$, NS, standard error of estimate: 6.6073. NS: Not significant, IOTN: Index of orthodontic treatment need, HS: Highly significant

Table 5: Backward stepwise multiple regression analysis of visual analog scale scores according to the total sample of laypersons (male and female laypersons) (dependent variable) with index of orthodontic treatment need

Input variables	Beta coefficient	SE of beta coefficient	Regression coefficient	SE of regression coefficient	t	P level	Significance
Intercept			37.9567	0.7828	48.4894	0.0000	S
IOTN	-0.2332	0.1235	-0.2439	0.1292	-1.8885	0.0636	S

$R=0.2332$, $R^2=0.05439$, Adjusted $R^2=0.0391$, $F(1, 62)=3.5663$, $P<0.06364$ SE of estimate: 4.4881, IOTN: Index of orthodontic treatment need, SE: Standard error, S: Significant

way although facial esthetics seem to be subjective and not a well-defined variable.^[10] When the various classes of Angle's classification were compared to different objective parameters, all the parameters, except the vertical parameter SN-GoGn, showed significant variation between the different classes. These parameters

were distinctly different despite overlapping ranges for different classes as indicated by the one-way ANOVA test done between the classes. However, no difference was found between two sexes of patients, when their objective parameters were compared. Kiekens *et al.* observed that the objective parameters used in his study showed



Figure 5: Microsoft power point demonstration to laypersons

wide overlapping ranges for different classes and none of them was decisive for Angle classification.^[5] In our study, however, the objective parameters were distinctly different between the classes but did not differ between the male and female subjects.

The comparison of different classes with respect to VAS scores given by male and female laypeople did not show significant differences, so it could be deduced that the laypeople were not appreciative of facial beauty with respect to different Angle classes. In this study, Class I and Class II/Division I malocclusions were rated lower than the Class II/Division II and Class III malocclusions as against the previous studies which rated Class II and Class III lower than Class I malocclusions.^[11] This could be interpreted that the laypeople of the area under study are more appreciative of a protrusive profile as against a straight or retrusive profile. The male laypeople gave higher esthetic scores than female laypeople showing that females were more critical in evaluating both male and female subjects than the males. However, this observation should be subjected to further research. When the esthetic scores given by male and female laypersons were compared with the objective measurements, the AC (IOTN) and the horizontal sum showed significant negative correlation with the subjective parameters. The horizontal sum, introduced by Kiekens *et al.* appeared to be a useful parameter to measure the horizontal discrepancy.^[5] It is related to the dentition (overjet) measured from the dental cast and to the skeletal parameter - ANB angle, measured on the lateral radiograph. However, when the esthetic values given by males and females separately were compared with the objective parameters, only the AC (IOTN) significantly correlated with the objective parameters, negatively. A multiple regression analysis of the subjective parameter, the VAS scores (dependent variable) with the objective parameters taken, indicated that only the AC (IOTN) was significant and negatively correlated and individually only female laypersons were negatively correlated and significant.

The laypeople gave the highest VAS score on the factors with a horizontal sum of 7.25 for male and 8.3 for female laypersons. The fact that for the variable horizontal sum, degrees, and millimeters are summed, might be surprising, but it appears to be reliable parameter (Cronbach's alpha = 0.7391). This finding was in accordance with the study by Kiekens *et al.*,^[5] Matoula and Pancherz found that the AP discrepancies, as measured by soft tissue ANB, showed minimal correlation with facial attractiveness.^[12] However, a trend emerged that would suggest that in faces where the ANB varies widely from 5°, the face is considered less attractive. The SN-GoGn angle was not significantly related to the esthetic scores. SN-GoGn angle, however, is a measure for mandibular rotation or growth direction and not for facial height.^[5] Romani *et al.* found that both orthodontists and layperson are sensitive to small horizontal changes and orthodontists are relatively less sensitive to vertical changes compared to the horizontal changes.^[13] Cochrane *et al.* studies showed that orthodontists are significantly more likely to choose Class I profile as most attractive and vast majority of the orthodontists and laymen considered Class II profile as least attractive.^[8] Michiels and Sather found profiles with increase vertical features or convex or Class II tendency profiles were judged as being most unattractive.^[14] In this study, however, Class II Division II and Class III malocclusions were judged as being more attractive than the Class II or Class I Angle malocclusion. Mugonzibwa *et al.* showed that the IOTN (AC) index appeared robust in its reflection of the perception of malocclusion by children and parents, respectively. Assessments were little affected by gender or ethnicity. However, the scores of children and parents were much lower than those of an orthodontist trained in the use of IOTN.^[15] Johansson and Follin found that photographs matching higher grades on the AC scale were perceived as the most unattractive, indicating what could be a layperson's priority when considering an orthodontic treatment policy in Tanzania.^[16] Synonymously, in this study, the AC/IOTN appeared to be a valuable indicator of facial esthetics and the higher grades on the scale were considered to be the most unattractive, whereas the lower scales were more attractive. The AC/IOTN, a measure of dental esthetics, appears to be the most vital contributor of facial esthetics and addition of horizontal sum increased the explained variance to 35. This increases the prognostic value of the AC/IOTN and horizontal sum when used in combination in evaluating facial esthetics, but the remaining 65% of the variance is left unaccounted for by these parameters and could probably be attributed to other facial features such as the eyes, skin, and hair.

Conclusion

The abovementioned study revealed that objective measurement showed overlapping between different Angle classes, but the differences were statistically significant for

each Angle classes. Correlation between esthetic scores done by male and female laypersons together with objective measurements showed that only AC/IOTN was negatively correlated and a statistically significant parameter. The prognostic value of the AC/IOTN increased when used with the horizontal sum in evaluating facial esthetics. Thus, horizontal sum was found to be a reliable variable for AP characteristics of the patient.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

References

- Dorsey J, Karabik K. Social and psychological motivations for orthodontic treatment. *Am J Orthod Dentofacial Orthop* 1977;72:460.
- Shaw WC, Gbe MJ, Jones BM. The expectations of orthodontic patients in South Wales and St. Louis, Missouri. *Br J Orthod* 1979;6:203-5.
- Tulloch C, Phillips C, Dann C 4th. Cephalometric measures as indicators of facial attractiveness. *Int J Adult Orthodon Orthognath Surg* 1993;8:171-9.
- Shaw WC, Rees G, Dawe M, Charles CR. The influence of dentofacial appearance on the social attractiveness of young adults. *Am J Orthod* 1985;87:21-6.
- Kiekens RM, Maltha JC, van't Hof MA, Kuijpers-Jagtman AM. Objective measures as indicators for facial esthetics in white adolescents. *Angle Orthod* 2006;76:551-6.
- De Smit A, Dermaut L. Soft-tissue profile preference. *Am J Orthod* 1984;86:67-73.
- Phillips C, Griffin T, Bennett E. Perception of facial attractiveness by patients, peers, and professionals. *Int J Adult Orthodon Orthognath Surg* 1995;10:127-35.
- Cochrane SM, Cunningham SJ, Hunt NP. A comparison of the perception of facial profile by the general public and 3 groups of clinicians. *Int J Adult Orthodon Orthognath Surg* 1999;14:291-5.
- Evans R, Shaw W. Preliminary evaluation of an illustrated scale for rating dental attractiveness. *Eur J Orthod* 1987;9:314-8.
- Howells DJ, Shaw WC. The validity and reliability of ratings of dental and facial attractiveness for epidemiologic use. *Am J Orthod* 1985;88:402-8.
- Kerr WJ, O'Donnell JM. Panel perception of facial attractiveness. *Br J Orthod* 1990;17:299-304.
- Matoula S, Pancherz H. Skeletofacial morphology of attractive and nonattractive faces. *Angle Orthod* 2006;76:204-10.
- Romani KL, Agahi F, Nanda R, Zernik JH. Evaluation of horizontal and vertical differences in facial profiles by orthodontists and lay people. *Angle Orthod* 1993;63:175-82.
- Michiels G, Sather AH. Determinants of facial attractiveness in a sample of white women. *Int J Adult Orthodon Orthognath Surg* 1994;9:95-103.
- Mugonzibwa EA, Kuijpers-Jagtman AM, van't Hof MA, Kikwilu EN. Comparison between the opinions of Tanzanian parents and their children on dental attractiveness. *Angle Orthod* 2004;74:63-70.
- Johansson AM, Follin ME. Evaluation of the aesthetic component of the Index of Orthodontic Treatment Need by Swedish orthodontists. *Eur J Orthod* 2005;27:160-6.