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Factors Affecting Smile Esthetics in Adults with Different Types of Growth Patterns.

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Abstract:*Introduction: Smile is one of the most essential human facial expressions. Earlier orthodontic treatment was only focused on teeth alignment, occlusal relationship and function. However, patients are more concerned about their facial esthetics. Most patients nowadays seek orthodontic treatment only for esthetic purposes. Therefore, it is important for an orthodontist to be able to assess smile esthetics in such patients. There have been numerous studies regarding smile esthetics, but there was lack of data on its effect on different growth patterns. Aim: To quantitatively assess the relationship between smile esthetics variables and different types of growth patterns. Method: Pretreatment frontal photographs of 60 adult patients were taken and divided into three groups according to the SN-MP angles, i.e. Horizontal growth, Average and Vertical growth pattern.The smile variables the arc ratio, number of maxillary teeth exposed, upper lip height, buccal corridor ratio, smile index, lower teeth exposure and interlabial gap were measured. ANOVA test was carried out to compare the smile variables of the three different groups. Results: Arch ratio: significantly more in vertical growth pattern when compared to average and horizontal growth pattern. Tooth number: the number of teeth exposed were significantly more in average when compared with horizontal and vertical growth pattern. Smile Index: Average growth pattern showed significantly lower smile index than vertical,while Horizontal showed greater smile index when compared with average as well as vertical growth patter).Interlabial gap: significantly greater in Average when compared to horizontal as well as vertical growth pattern. Conclusion:With change in growth pattern the smile parameters which showed significant changes are arch ratio, tooth number, smile index and interlabial gap. On comparing Average growth pattern with horizontal growth pattern, smile index was higher in average growth pattern while the numer of maxillary teeth exposed and interlabial gap are higher in horizontal growth pattern.On comparing Vertical growth pattern with average growth pattern, arch ratio and smile index are higher in vertical growth pattern while interlabial gap and tooth exposure are higher in average growth pattern. The smile index is higher in Horizontal growth pattern than in vertical growth pattern while the arch ratio is higher in vertical growth pattern than horizontal growth pattern.*

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I. Introduction

The smile is one of the most essential human facial expressions[1] that enhances the reward value of an attractive face.[2] It is defined as a facial expression characterized by upward curving of the corners of the mouth, is often used to indicate pleasure, amusement, or derision.[1] Ackerman et al.[3] have suggested that not all successfully treated orthodontic patients with excellent occlusal relationships and exemplary plaster models have acceptable esthetics when smiling. In traditional orthodontic treatment, orthodontists focus on teeth alignment, occlusal relationship, and function. Patients, however, are concerned about their facial esthetics, particularly smile esthetics. Most patients seek orthodontic treatment for esthetic purposes. Therefore, it is essential for an orthodontist to be able to assess smile esthetics in a patient.There are two forms of smiles—the enjoyment or Duchenne smile and the posed or social smile. The posed smile is voluntary and not elicited by an emotion. In other words, it is reliably reproducible and can be sustained. Posed smiles, therefore have importance in orthodontic diagnosis and treatment planning.

The unposed or social smile, however, is involuntary and is induced by joy or mirth. It is a natural response as it expresses authentic human emotion.[4]

Smile analysis and smile design have become key elements of orthodontic diagnosis and treatment planning over the last decade.[5] Smile design is a multifactorial process, with clinical success determined by an understanding of the patient's soft-tissue treatment limitations and the extent to which orthodontics or multidisciplinary treatment can satisfy the patient's and orthodontist's esthetic goals.

Various factors contribute to smile esthetics. Regarding orthodontic treatment, Hulsey[6] was the first to quantify the lip-teeth relationship during smiling. He measured the smile line ratio, smile symmetry ratio, buccal corridor ratio, upper lip height, and upper lip curvature and concluded that smile line ratio close to 1 produced an attractive smile. Sarver[3] defined the ideal smile arc as the curvature of the incisal edges of the maxillary incisors and canines parallel to the curvature of the lower lip upon smiling. Orthodontists' lack of consideration of the smile arc in treatment planning and mechanics was reported recently, resulting in flattening of the smile arc and less esthetic smiles. The main reason cited for this was that more attention was placed on tooth measurements while positioning brackets, causing compromise in the curvature of the maxillary incisal edges.[7]

The success of orthodontic treatment can be determined by various objective measures. However, society and patients predominantly focus on the final esthetic outcome,[8] which can be quite subjective to judge. Therefore, numerous clinical and experimental studies have attempted to define how an esthetically pleasing smile can be achieved after orthodontic treatment. As a result, buccal corridors,[9–11] smile arc,[4,12] incisor protrusion,[8,13] and gingival display[8] have commonly been cited as the potential characteristics that influence the esthetic outcome of an orthodontically treated patient. Our current knowledge suggests that alterations in these variables directly affect a person's esthetic perception.

Numerous studies have been published regarding smile esthetics. Some investigations have applied quantitated or quantified measurements to analyze the lip-teeth relationship.[14,15] Some other studies have assessed smiles by employing subjective esthetic evaluation, wherein evaluators were asked to rank the attractiveness of the participants' smiles.[15-18]

There have been numerous studies regarding smile esthetics, but there was lack of data on its effect on different growth patterns. Therefore, the aim of this study is to quantitatively assess the relationship between smile esthetics variables and different types of growth patterns.

Objectives : The objectives drawn for this study were,

- To evaluate the different smile parameters- arch ratio, upper lip height, number of maxillary teeth exposed, Buccal corridor ratio, smile index, lower teeth exposure and interlabial gap in horizontal growth, average growth and vertical growth patterns.
- To compare these smile variables in different growth patterns.

II. Material and Methods

The records collected were from the patients who were treated in MGV's KBH Dental College and Hospital, Nashik. To be included in this study, patients had to satisfy the following criteria: (1) the patient's age at the time of treatment initiation was > 18 years; (2) an intact set of diagnostic pretreatment records was available, including study models, panoramic radiographs, and intra- and extraoral photograph series; and (3) pretreatment posed smile photographs had been taken with the patient's eyes open and a natural-looking posed smile. Exclusion criteria included – (1) missing teeth that could be visible in a smile; (2) any visible prosthodontic work; (3) excessive dental attrision; (4) previous history of orthodontic treatment. The participants were divided into the following 3 groups by their growth patterns according to the SN-MP angle: Group A (7males 13females) (Horizontal growth pattern $\leq 28^{\circ}$), Group B(12males 8females) (Average growth pattern 28°-32.5°) and Group C (9males 11females)(Vertical growth pattern $\geq 32.5^{\circ}$).

The photographs were then cropped. The frame showed the subjects' widest commissure to commissure smile (Figure 1). Seven smile variables were then measured on these photographs. The smile variables measured were the arc ratio, number of maxillary teeth exposed, upper lip height, buccal corridor ratio, smile index, lower teeth exposure and interlabial gap. All these variables were evaluated as ratio except the tooth number (Table 1). These were then compared among different groups and their relationship to them was assessed.

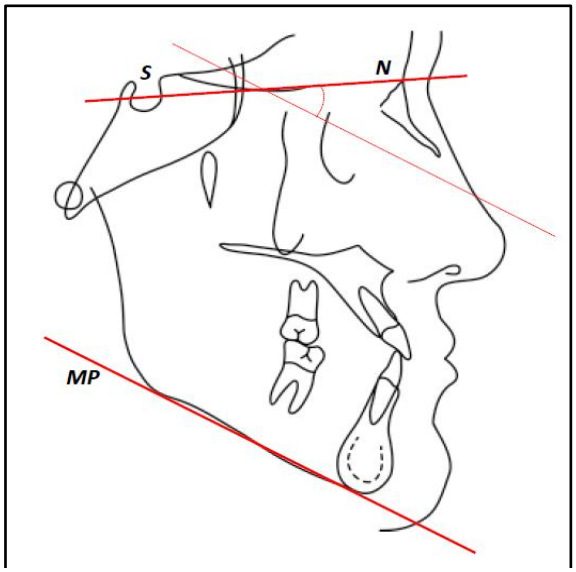

Figure 1 : Cephalometric Landmarks and SN(Sella-Nasion)-MP(Mandibular Plane) angle used for dividing groups according to different Growth Patterns.

Figure 2 : Smile measurements. **A**, Arch ratio; **B**, Upper Lip height; **C**, Buccal corridor ratio; **D**, Smile Index; **E**, Lower teeth exposure; **F**, Interlabial gap.

Table 1 : Definations of smile esthetic variables used in this study.

SMILE VARIABLES	DEFINATION
Tooth Number	Number of the exposed teeth in the maxilla
Upper lip height	The shortest distance from the incised edge of tooth 11 to the lower border of the upper lip / mesio-distal width of tooth 11
Buccal corridor ratio	Intercommissure width / intercanine width
Smile index	Intercommissure width / interlabial gap
Lower teeth exposure	Distance from the incisal edge of tooth 11 to upper border of the lower lip / mesio-distal width of tooth 41
Interlabial gap	Interlabial gap / intercanine width

Statistical analysis

All statistical analysis were done by the SPSS 17.0 software.

Analysis of variance (ANOVA) was used to compare the pretreatment smile esthetic variables between the 3 groups. A post hoc test was then performed using the Tukey-Kramer Multiple comparisons test. The level of significance was set at $p < 0.05$.

III. Result

The smile analysis showed that, except for the upper lip height, buccal corridor ratio and lower teeth exposure all of the smile measurements differed significantly among the groups before orthodontic treatment (Table 2). Tooth number, smile index and interlabial gap showed significant results between Group A and B. Arch ratio and smile index differed significantly between Group A and C. Arch ratio, tooth number, smile index and interlabial gap showed significant results between Group B and C.

1. Arch ratio : significantly more in vertical growth pattern (0.86 + 0.34) when compared to average (0.61 + 0.34) and horizontal growth pattern (0.58 + 0.38).
2. Tooth number : the number of teeth exposed were significantly more in average growth pattern (9.9 + 1.3) when compared with horizontal(8.3 + 1.4) and vertical growth pattern (8.2 + 1.6)
3. Smile Index : Average growth pattern (5.1 + 0.5) showed significantly lower smile index than vertical growth pattern(6.1 + 0.5), while Horizontal growth pattern(6.7 + 0.5) showed greater smile index when compared with average(5.1 + 0.5) as well as vertical growth pattern(6.1 + 0.5).
4. Interlabial gap : significantly greater in Average growth pattern(0.4 + 0.8) when compared to horizontal(0.25 + 0.7) as well as vertical growth pattern(0.29 + 0.6)

Table 2 : Descriptive analysis of smile variables.

Smile Variables	A			B			C		
	Mean	Standard Deviation	P Value	Mean	Standard Deviation	P Value	Mean	Standard Deviation	P Value
Arch Ratio	0.58	0.38	>0.1	0.61	0.21	>0.1	0.86	0.34	0.003
Tooth Number	8.3	1.49	0.012	9.9	1.33	0.001	8.2	1.6	>0.1
Upper Lip Height	1.01	0.15	0.001	1.04	0.26	>0.1	0.95	0.28	0.052
Buccal Corridor Ratio	1.65	0.17	>0.1	1.7	0.2	>0.1	1.7	0.15	>0.1
Smile Index	6.7	0.51	>0.1	5.16	0.54	>0.1	6.1	0.51	>0.1
Lower Teeth Exposure	0.39	0.4	0.004	0.39	0.25	0.01	0.31	0.41	<0.0001
Interlabial Gap	0.26	0.07	>0.1	0.46	0.09	>0.1	0.3	0.07	0.003

P value *<0.05 significant;
**<0.01 highly significant;
***<0.001 extremely significant.

Table 3 : Comparison of smile measurements between different types of growth patterns using ANOVA

SMIILE VARIABLES	A vs B	B vs C	A vs C
ARCH RATIO	P<0.05	p>0.05	p>0.05
	Non Significant	Significant	Significant
TOOTH NUMBER	P<0.01	P<0.01	P>0.05
	Highly Significant	Highly Significant	Non Significant
UPPER LIP HEIGHT	P>0.05	P>0.05	P>0.05
	Non Significant	Non Significant	Non Significant
BUCCAL CORRIDOR RATIO	P>0.05	P>0.05	P>0.05
	Non Significant	Non Significant	Non Significant
SMILE INDEX	P>0.001	P>0.001	P>0.01
	Extremely Significant	Extremely Significant	Highly Significant
LOWER TEETH EXPOSURE	P>0.05	P>0.05	P>0.05
	Non Significant	Non Significant	Non Significant
INTERLABIAL GAP	P>0.001	P>0.001	P>0.05
	Extremely Significant	Extremely Significant	Non Significant

P>0.05 non significant, *P<0.05 significant,
**P<0.01 highly significant,
***P<0.001 extremely significant

IV. Discussion

In this study, we quantitatively assessed the relationship of smile esthetic variables with different types of growth patterns. There have been fewer studies to assess variations in smile variables by considering the growth patterns. Cheng et al[19] in his study have quantitatively assessed the relationship of smile esthetic variables with various types of anterior Overjet malocclusion, and identified the cephalometric factors affecting smile measurements.

Various investigative methods have been adopted to investigate smile esthetics; they have generally been divided into two types of evaluation i.e, subjective evaluation and objective evaluation. The limitation of subjective evaluation is that the perception of esthetics varies from person to person and is influenced by personal experiences and social environments.[20] Many esthetic concepts regarding the face and smile are based on the opinions of authors instead of on reliable scientific methods.[21] While objective evaluation, involves quantifying smile variables from photographs.[3,6] In our study we used objective evaluation to analyze smile characteristics. We used ratios instead of a numerical value. The definition of each smile variable was a ratio (a/b%) used to minimize errors and increase reliability.

Arch ratio :

It was significantly greater in vertical growth pattern when compared to average growth pattern as well as horizontal growth pattern.

Upper lip height:

The upper lip height was shortest in vertical growers than both average and horizontal growers. But the differences were insignificant. Vig and Brundo[22] in their study stated that people with short upper lips display more maxillary tooth structure than with long upper lips. Though the results were insignificant this is in support of our study as the arch ratio is greater in vertical growers while the upper lip height is shorter in the same.

Tooth number :

The number of maxillary teeth exposed were significantly more in average growth pattern when compared with horizontal growth pattern and vertical growth pattern. The number of teeth displayed on smiling has been described by Tjan et al[23] and Yoon et al[24], they said that smiles which show first molar to first molar are judged the most attractive and these are closely followed by smiles which show second premolar to second

premolar and second molar to second molar. A study was done by Kim and Giannelly[25] in which they compared the esthetics of smiles in extraction and non-extraction cases without arch expansion and could find no difference between the two groups.

Buccal corridor ratio :

The buccal corridor ratio was least in horizontal growers and was greater in average growers but the results were insignificant. This findings were in support of the study done by Hulsey[6], who reported that lay persons had no preference regarding buccal corridor width and that width variations seemed to be of no significance in determining smile attractiveness. However he had qualitatively assessed the buccal corridor ratio by calculating the intercanine width/smile width ratio and did not take into account any visible dentition distal to the maxillary canines. In another study done by Frush and Fisher[26], they defined buccal corridors as the spaces between the buccal surfaces of the posterior teeth and the corners of the mouth when smiling. In our study, we did not actually examine buccal corridors as defined by Frush and Fisher. Also, we used pictures limited to mouths as given by Hulsey. Martin[27] 2007 et al suggest that studies which have found no difference in preference between large and small buccal corridors have used intercanine width rather than visible maxillary dentition for calculating buccal corridor ratios, as done in our study.

Smile Index :

The smile index was described by Ackerman et al[3] (1998) according to which, the lower the smile index, the less youthful the smile appears (because there is relatively less tooth display). In our study, Average growth pattern showed significantly lower smile index than vertical growth pattern, hence less youthful smile. While Horizontal growth pattern showed greater smile index when compared with average growth pattern as well as vertical growth pattern, meaning more youthful smile.

In a study by Marc B. Ackerman et al.[28], he stated that high smile index values are because of the commisures of the lips moving significantly more superiorly and laterally in the posed smile, hence, the spatial change at the commisures directly affects the amount of percent incisor below the intercommisure line, and the increase in smile width will proportionately increase smile index.

Lower teeth exposure :

Lower teeth exposure was less in vertical growth pattern than horizontal as well as average growth pattern

Interlabial gap :

Interlabial gap ratio was significantly greater in Average growth pattern when compared to horizontal growth pattern as well as vertical growth pattern. This results were in contrast to those in the study done by Grover et al[29], in which Interlabial gap was significantly found to be maximum in vertical growers, followed by average and least in horizontal growers.

The advantage of using a frontal facial photograph for analysis in this study was that the process was simple and cost-effective, easily available in clinical practice.[30] However, it has been reported that evaluation of smile esthetics using this method poses a major difficulty in precise capture of repeatable and reliable image at one or multiple time points.[31] Another limitation was the difficulty in obtaining a natural smiling photograph as the patients did not have a well-aligned occlusion before orthodontic treatment, they might have felt shy in smiling.[30] In a study done by Grover et al[29], recording of smile was done by digital videography. It has been noted that standardized digital videography provides the clinician with a wider range of images for selecting the parameters, and that it is possible to select similar images at different time points from these multiple frame galleries to effectively compare the "same" posed social smile. However, Schabel et al.[32] found that there is no clinically significant difference between the images of smiles of subjects captured by clinical photography and the smiles of the same subjects obtained from digital video clips.

This study confirmed that the smile pattern varies between different types of growth patterns. However, analysis of dynamic facial characteristics by using 2-dimensional photographs of patients is difficult. So, 3-dimensional methodology could be used for this purpose.

V. Conclusion

- With change in growth pattern the smile parameters which showed significant changes are arch ratio, tooth number, smile index and interlabial gap.
- On comparing Average growth pattern with horizontal growth pattern, smile index was higher in average growth pattern while the numer of maxillary teeth exposed and interlabial gap are higher in horizontal growth pattern.
- On comparing Vertical growth pattern with average growth pattern, arch ratio and smile index are higher in vertical growth pattern while interlabial gap and tooth exposure are higher in average growth pattern.

- The smile index is higher in Horizontal growth pattern than in vertical growth pattern while the arch ratio is higher in vertical growth pattern than horizontal growth pattern.
- Orthodontists must therefore, take into account the smile esthetics during diagnosis, treatment planning, and treatment mechanisms before orthodontic treatment.

References

[1]. O'Doherty J, Winston J, Critchley H, Perrett D, Burt DM, Dolan RJ. Beauty in a smile: the role of medial orbitofrontal cortex in facial attractiveness. Neuropsychologia 2003;41:147-55.
[2]. Schmidt KL, Cohn JF, Tian Y. Signal characteristics of spontaneous facial expressions: automatic movement in solitary and social smiles. BiolPsychol ;65:49-66.
[3]. Ackerman JL, Ackerman MB, Brensinger CM, Landis JR. A morphometric analysis of the posed smile. ClinOrthod Res 1998;1:2-11.
[4]. Sarver DM. The importance of incisor positioning in the esthetic smile: the smile arc. Am J OrthodDentofacialOrthop 2001;120:98-111.
[5]. Morley, J. and Eubank, J.: Macroesthetic elements of smile design, J. Am. Dent. Assoc. 132:39-45, 2001.
[6]. Hulsey CM. An esthetic evaluation of lip-teeth relationships present in the smile. Am J Orthod 1970;57:132-44.
[7]. Wong NKC, Kassim AA, Foong KWC. Analysis of esthetic smiles by using computer vision techniques. Am J OrthodDentofacialOrthop 2005;128:404-11.
[8]. Is¸iksal E, Hazar S, Akyalc¸in S. Smile esthetics: perception and comparison of treated and untreated smiles.AmJOrthodDentofacialOrthop. 2006;129:8–16.
[9]. Ioi H, Nakata S, Counts AL. Effects of buccal corridors on smile esthetics in Japanese. Angle Orthod. 2009;79:628–633.
[10]. Martin AJ, Buschang PH, Boley JC, Taylor RW, McKinney TW. The impact of buccal corridors on smile attractiveness. Eur J Orthod. 2007;29:530–537.
[11]. Chang CA, FieldsHWJr, Beck FM, et al. Smile esthetics from patients' perspectives for faces of varying attractiveness. Am J OrthodDentofacialOrthop. 2011;140:e171–e180.
[12]. Ioi H, Kang S, Shimomura T, et al. Effects of buccal corridors on smile esthetics in Japanese and Korean orthodontists and orthodontic patients. Am J OrthodDentofacialOrthop. 2012;142:459–465.
[13]. McNamara L, McNamara JA Jr, Ackerman MB, Baccetti T. Hard- and soft-tissue contributions to the esthetics of the posed smile in growing patients seeking orthodontic treatment. Am J OrthodDentofacialOrthop. 2008;133:491–499.
[14]. Akyalcin S, Frels LK, English JD, Laman S. Analysis of smile esthetics in American Board of Orthodontic patients. Angle Orthod 2014;84:486-91.
[15]. Krishnan V, Daniel ST, Lazar D, Asok A. Characterization of posed smile by using visual analog scale, smile arc, buccal corridor measures, and modified smile index. Am J OrthodDentofacialOrthop 2008;133:515-23.
[16]. Havens DC, McNamara JA Jr, Sigler LM, Baccetti T. The role of the posed smile in overall facial esthetics. Angle Orthod 2010;80:322-8.
[17]. Springer NC, Chang C, Fields HW, Beck FM, Firestone AR, Rosenstiel S, et al. Smile esthetics from the layperson's perspective. Am J OrthodDentofacialOrthop 2011;139:e91-101.
[18]. Schabel BJ, Franchi L, Baccetti T, McNamara JA Jr. Subjective vs objective evaluations of smile esthetics. Am J OrthodDentofacialOrthop 2009;135(4 Suppl):S72-9.
[19]. Cheng HC, Cheng PC. Factors affecting smile esthetics in adults with different types of anterior overjet malocclusion. Korean J Orthod 2017;47(1):31-38.
[20]. Springer NC, Chang C, Fields HW, Beck FM, Firestone AR, Rosenstiel S, et al. Smile esthetics from the layperson's perspective. Am J OrthodDentofacialOrthop 2011;139:e91-101
[21]. Pinho S, Ciriaco C, Faber J, Lenza MA. Impact of dental asymmetries on the perception of smile esthetics. Am J OrthodDentofacialOrthop 2007;132:748-53.
[22]. Vig RG, Brundo GC. The kinetics of anterior tooth display. J Prosthet Dent. 1978;39:502–4.
[23]. Tjan AHL, Miller GD and The JGP (1984) Some aesthetic factors in a smile Journal of Prosthetic Dentistry 51: 24-28.
[24]. Yoon ME, Jin TH and Dong JK (1992) A study on the smile in Korean youth Journal of the Korean Academy of Prosthodontics 30: 259-270.
[25]. Kim E and Giannelly AA (2003) Extraction versus non-extraction: arch widths and smile aesthetics Angle Orthodontist 73: 354-358.
[26]. Frush JP, Fisher RD. The dynesthetic interpretation of the dentogenic concept. J Prosthet Dent 1958;8:558-81.
[27]. Martin AJ, Buschang PH, Boley JC, Taylor RW and McKinney TW (2007) The impact of buccal corridors on smile attractiveness European Journal of Orthodontics 29: 530-537.
[28]. Marc B. Ackerman, Colleen Brensinger and Richard Landis. An evaluation of dynamic lip-tooth characteristics during speech and smile in adolescents. Angle Orthod 2004; 74: 43-50.
[29]. Grover N , Kapoor DN, Verma S and BharadwajP.Smile analysis in different facial patterns and its correlation with underlying hard tissues. ProgOrthod 2015; 16:28.
[30]. Islam R, Kitahara T, Naher L, Hara A, Nakasima A. Lip morphological changes in orthodontic treatment. Class II division 1: malocclusion an normal occlusion at rest and on smiling. Angle Orthod 2009;79:256-64.
[31]. Ackerman MB, Brensinger C, Landis JR. An evaluation of dynamic lip-tooth characteristics during speech and smile in adolescents. Angle Orthod 2004;74:43-50.
[32]. Schabel BJ, Baccetti T, Franchi L, McNamara JA. Clinical photography vs digital video clips for the assessment of smile esthetics. Angle Orthod 2010;80:490-6.