Evaluation of Smile Esthetics among Orthodontists, General Dentist and Laypersons With Respect To Asymmetries of the Maxillary Incisor Edge

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Abstract: Smile plays an important role in facial expression and appearance, it is considered as the universal friendly greeting in all cultures. Study was conducted to determine perception of smile esthetics among orthodontists, general dentist and laypersons with respect to asymmetries of the maxillary incisor edge in a front smile analysis. Facial and dental esthetics plays an important role in quality of life. Esthetic concerns about the smile are often patient's main reason for seeking dental care. From present study, it can be shown that the orthodontist and general dentists groups perceived the change in incisor edge asymmetry in a much higher frequency than the laypersons. This has implications for the choice of the procedure to be performed. Hence, as an orthodontist, we need to consider this during treatment planning, and opt for a treatment that does not alter the esthetics and harmony of the smile.
Keywords: Smile Esthetics, Orthodontists, General Dentist, Laypersons.

INTRODUCTION

Smile plays an important role in facial expression and appearance, it is considered as the universal friendly greeting in all cultures [1, 2]. A harmonious smile plays an important role in establishing a good relationship between physical and facial beauty, as teeth are considered important components in the architecture of facial disposition [3, 4]. A century ago, the orthodontic paradigm was geared toward achieving optimal proximal and occlusal contacts of the teeth within the framework of a balanced profile. When cephalometric-based diagnosis and treatment planning hit full stride in the 1950s and 1960s, esthetics in orthodontics was defined primarily in terms of the profile.

The present emphasis, however, is toward enhancing facial esthetics and creating a beautiful smile [5]. Recent studies also have shown that perception of facial esthetics, including self-perception contributes significantly to reasons for seeking orthodontic treatment [6, 7].

Esthetics in dentistry has increasingly become a major concern for patients and often serves as a primary reason for seeking dental care. To obtain optimal aesthetic result, it is of paramount importance for clinician to follow aesthetic guidelines [8]. Dental esthetics can affect not only facial but also social attractiveness. Shaw *et al.* showed that persons with normal incisor relationships were viewed as being friendlier, popular, and intelligent and in a higher social class than those with an abnormal dental arrangement [9].

The aesthetic perception varies from person to person and is influenced by the personal experience and social environment. Even a well-treated orthodontic case in which the final records meet every criterion of the American Board of Orthodontics for successful treatment may not produce an aesthetic smile. Beside, professional opinions regarding evaluation of smile aesthetics may not coincide with the perceptions and expectations of laypeople.

The literature suggests that orthodontists, dentists and laypersons have different perception on smile esthetics while evaluating oro-facial characters. The orthodontists are more sensitive in evaluating the deviation from ideal [10].

To provide more objective guidelines regarding the perception of smile esthetics, numerous studies were performed by using digital image manipulation. Thereby some characters were better elucidated i.e., smile arc, amount of gingival display, type of buccal corridors and presence of dental and gingival asymmetries, presence of midline diastema, influence of midline and long axis deviation and importance of maxillary incisor size and proportions.

With this above background this study was conducted to determine perception of smile esthetics among orthodontists, general dentist and laypersons with respect to asymmetries of the maxillary incisor edge in a front smile analysis.

MATERIALS & METHODS

1 female and 1 male student (20-28yrs) were chosen who have a good facial proportion with skeletal class I profile, attractive smile and follow the principles of ideal smile described in the literature. Adequate width and length proportions of teeth in esthetic zone, convex smile arc, gingival display less than 1mm , gingival line of central incisor matching with canine and the lateral incisor slightly below and progressive increase in depth of tooth embrasures from central incisors to canine.

Three groups of raters were selected

First group consist of 30 lay persons (15 men and 15 women) in the age group of 20 to 35, selected among the patients visiting the Department of Orthodontics and Dentofacial Orthopaedics, Rajarajeswari Dental College and Hospital, Mysore road, Bangalore.

Second group consist of 30 General Dentists (15 male and 15female) selected randomly from Bangalore city.

Third group consist of 30 Orthodontists (15 male and 15female) selected randomly from Bangalore city.

INCLUSION CRITERIA
Frontal facial image
- Subjects having a good facial proportion and skeletal class 1 profile.
- Subjects having an average smile line, revealing 100% of the maxillary anterior teeth.
- Subjects having good dental alignment and tooth size symmetry.

Raters
- Lay people
- General Dentists
- Orthodontists.

EXCLUSION CRITERIA
Frontal facial images
- Restored anterior teeth.
- Abraded anterior teeth.
- Anterior tooth size asymmetry.

- History of traumatic injuries.

A written consent was taken from the subjects/ parents / guardians prior to taking the frontal facial photographs.

- Identification of the subjects based on inclusion criteria and exclusion criteria. Two standardized color photographs of the subjects (smiling frontal view and smiling lower facial third view) a male and female subject matching inclusion criterion was obtained using a digital camera (CANON SLR EOS 1200 D) with the subject maintaining the natural head position (Fig. 2a, 2b).

- Photographs are scanned using commercially available Adobe Photoshop CS.
- The selected images are altered digitally using Adobe Photoshop CS.
- The photos were manipulated to produce symmetrical images and were then retouched to adjust color, brightness and contrast as well as to remove any discolorations on the lip and skin.
- Each new image was altered to produce incisor edge asymmetry, 0.5mm increments on the incisor edge of the maxillary left central and maxillary left lateral incisor coding for the photographs was done as mentioned in table 1.
- Booklet of each subject was prepared with 7 photographs
- Each rater was given abrief information about the study and asked to evaluate the attractiveness of image.
- Along with album each rater receives a form with 100mm Visual Analogue

Scale (VAS) printed for each image. The scale will have a range from very unattractive on the far left to very attractive at the far right. A line also will be printed at the midpoint of the Scale to provide reference line for an average level of attractiveness (Figure 1)

Booklet with 28 images was provided to the raters along with seven 100mm visual analogue scale (VAS) rating form and a questionnaire. The questions were aimed at detecting the esthetic preference of the raters. The questionnaire was completed by the raters.

The ratings given by each rater was duly tabulated for each questionnaire of both the subjects.

Coding for photographs

Table-1: Coding for photographs

FA	female smiling frontal photograph
FB	female smiling lower facial third photograph
MA	male smiling frontal photograph
MB	male smiling lower facial third photograph

Table-2: Numbering for photographs

1	0mm (unaltered)
2	0.5 mm left central
3	1 mm left central
4	1.5 mm left central
5	0.5 mm left lateral
6	1 mm left lateral
7	1.5 mm left lateral

Fig-1: Canon Digital Camera 1200-D

Fig-2a: Frontal photograph – female

Fig-2b: Frontal photograph –male

Fig 3a: Lower third smile photograph Female

Fig-3b: Lower third smile photograph Male

Fig-4: Frontal smile photograph female – FA1: Ideal smile, FA2:0.5 mm left central incisor asymmetry, FA3:1 mm left central incisor asymmetry, FA4: 1.5 mm left central incisor asymmetry, FA5: 0.5mm left lateral incisor asymmetry, FA6: 1mm left lateral incisor asymmetry and FA7: 1.5mm left lateral incisor asymmetry

Fig-5: Lower third smile photograph female – FB1: Ideal smile, FB2:0.5 mm left central incisor asymmetry, FB3:1 mm left central incisor asymmetry, FB4: 1.5 mm left central incisor asymmetry, FB5: 0.5mm left lateral incisor asymmetry, FB6: 1mm left lateral incisor asymmetry and FB7: 1.5mm left lateral incisor asymmetry
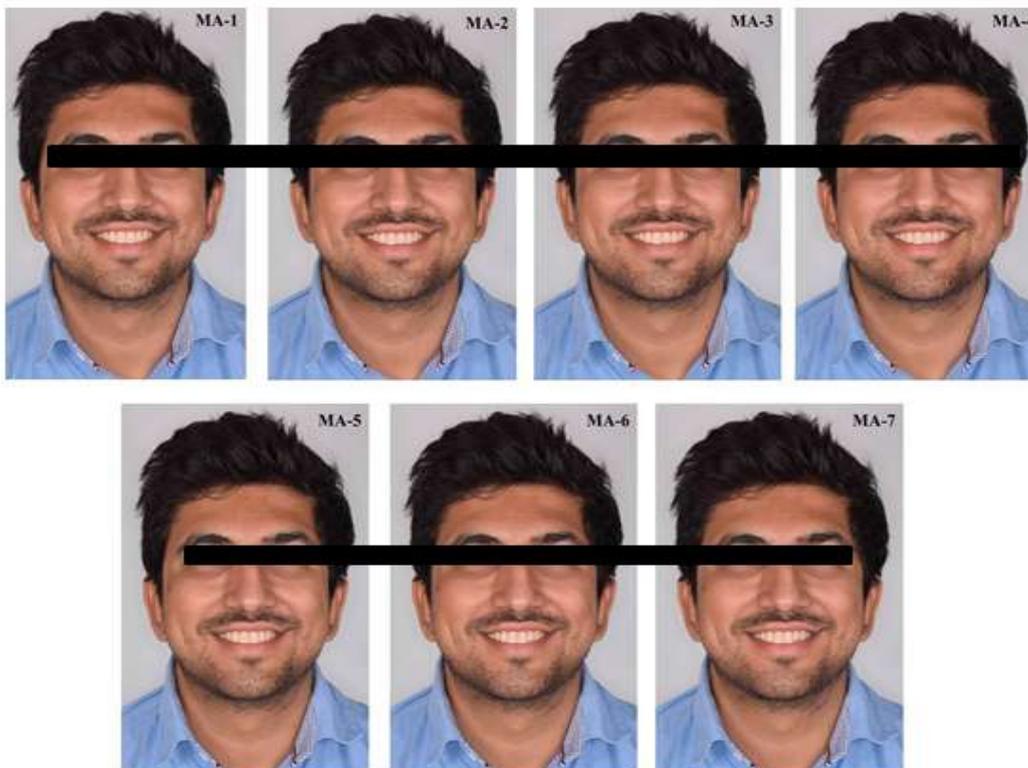

Fig-6: Frontal smile photograph male – MA1: Ideal smile, MA2:0.5 mm left central incisor asymmetry, MA3:1 mm left central incisor asymmetry, MA4: 1.5 mm left central incisor asymmetry, MA5: 0.5mm left lateral incisor asymmetry, MA6: 1mm left lateral incisor asymmetry and MA7: 1.5mm left lateral incisor asymmetry

Fig-7: Lower third smile photograph male – MB1: Ideal smile, MB2:0.5 mm left central incisor asymmetry, MB3:1 mm left central incisor asymmetry, MB4: 1.5 mm left central incisor asymmetry, MB5: 0.5mm left lateral incisor asymmetry, MB6: 1mm left lateral incisor asymmetry and MB7: 1.5mm left lateral incisor asymmetry

Visual Analogue Scale (VAS)
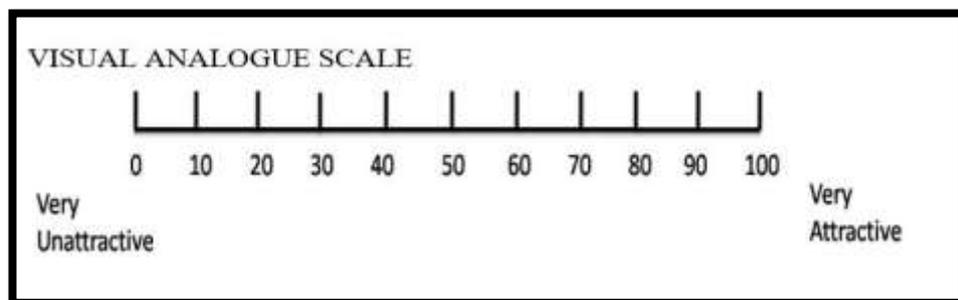
Questionnaire

If this image you are evaluating represented your own image, will you seek orthodontic treatment?

☐ YES   ☐

STATISTICAL ANALYSIS

The following methods of statistical analysis have been used in this study. Data was entered in Microsoft excel and analyzed using SPSS (Statistical Package for Social Science, Version 22.0, Released 2013. Armonk,NY: IBM. corp) package. The results were averaged (mean + standard deviation) for continuous data and number and percentage for dichotomous data are presented in Table and graph. One way analyses of variance (ANOVA) followed by Tukey's HSD Post Hoc analysis were used to compare the mean VAS scores between the 3 study groups for Male and Female Patients smile photographs.

Independent Student t test was used to perform gender based comparison of mean VAS scores between 03 groups for Male and female patients' smile face & smile close Photographs in each rater group.

Table-4: Comparison of mean VAS scores between 03 groups for female patient's Smile face Photographs [FA1 – FA7]

Variable	Groups	N	Mean	SD	Std. Error	ANOVA Test		Tukey's HSD Post hoc	
						F	P-Value	Sig. Diff	P-Value
FA1	Orthodontist	30	95.3	6.3	1.1	17.528	<0.001*	O Vs D	0.02*
	Dentist	30	91.0	8.0	1.5			O Vs L	0.008*
	Layperson	30	100.0	0.0	0.0			D Vs L	<0.001*
FA2	Orthodontist	30	57.0	7.5	1.4	57.349	<0.001*	O Vs D	<0.001*
	Dentist	30	68.7	7.8	1.4			O Vs L	<0.001*
	Layperson	30	78.3	7.9	1.4			D Vs L	<0.001*
FA3	Orthodontist	30	34.7	5.1	0.9	45.083	<0.001*	O Vs D	<0.001*
	Dentist	30	48.7	7.8	1.4			O Vs L	<0.001*
	Layperson	30	51.3	8.6	1.6			D Vs L	0.34
FA4	Orthodontist	30	4.7	5.7	1.0	53.826	<0.001*	O Vs D	<0.001*
	Dentist	30	18.7	6.8	1.2			O Vs L	<0.001*
	Layperson	30	20.3	6.7	1.2			D Vs L	0.58
FA5	Orthodontist	30	81.7	7.5	1.4	21.414	<0.001*	O Vs D	<0.001*
	Dentist	30	93.0	7.5	1.4			O Vs L	<0.001*
	Layperson	30	93.7	8.9	1.6			D Vs L	0.94
FA6	Orthodontist	30	46.3	9.6	1.8	36.848	<0.001*	O Vs D	<0.001*
	Dentist	30	65.7	8.2	1.5			O Vs L	<0.001*
	Layperson	30	58.0	8.5	1.5			D Vs L	0.003*
FA7	Orthodontist	30	6.0	6.7	1.2	14.573	<0.001*	O Vs D	<0.001*
	Dentist	30	16.0	11.6	2.1			O Vs L	<0.001*
	Layperson	30	18.7	9.7	1.8			D Vs L	0.53

Table-5: Comparison of mean VAS scores between 03 groups for female patient's Close smile Photographs [FB1 - FB7]

| Variable	Groups	N	Mean	SD	Std. Error	ANOVA Test		Tukey's HSD Post hoc	
						F	P-Value	Sig. Diff	P-Value
FB1	Orthodontist	30	92.3	4.3	0.8	15.615	<0.001*	O Vs D	<0.001*
	Dentist	30	97.3	4.5	0.8			O Vs L	<0.001*
	Layperson	30	98.0	4.1	0.7			D Vs L	0.82
FB2	Orthodontist	30	71.7	5.9	1.1	29.157	<0.001*	O Vs D	<0.001*
	Dentist	30	82.3	7.7	1.4			O Vs L	<0.001*
	Layperson	30	84.7	7.3	1.3			D Vs L	0.41
FB3	Orthodontist	30	39.7	7.6	1.4	82.985	<0.001*	O Vs D	<0.001*
	Dentist	30	51.7	8.3	1.5			O Vs L	<0.001*
	Layperson	30	66.3	8.1	1.5			D Vs L	<0.001*
FB4	Orthodontist	30	8.0	8.1	1.5	149.677	<0.001*	O Vs D	<0.001*
	Dentist	30	25.7	5.0	0.9			O Vs L	<0.001*
	Layperson	30	37.3	6.4	1.2			D Vs L	<0.001*
FB5	Orthodontist	30	80.3	7.6	1.4	12.689	<0.001*	O Vs D	<0.001*
	Dentist	30	90.0	8.7	1.6			O Vs L	<0.001*
	Layperson	30	89.7	8.9	1.6			D Vs L	0.99
FB6	Orthodontist	30	46.3	7.6	1.4	16.080	<0.001*	O Vs D	0.006*
	Dentist	30	54.0	10.0	1.8			O Vs L	<0.001*
	Layperson	30	60.0	10.2	1.9			D Vs L	0.04*
FB7	Orthodontist	30	5.3	5.1	0.9	17.684	<0.001*	O Vs D	<0.001*
	Dentist	30	16.3	11.6	2.1			O Vs L	<0.001*
	Layperson	30	19.3	10.7	2.0			D Vs L	0.46

RESULTS

Table 3 shows gender distribution in the groups. They were equally distributed among 3 groups for layperson, dentist and orthodontist as well as for male and female raters.

Table 4 to Table 7 shows the attractiveness scores and treatment need means and standard deviations of the scores. The data showed that there were significant variations in the perception of the differences in the photographs except lower third close smile photograph of a male patient.

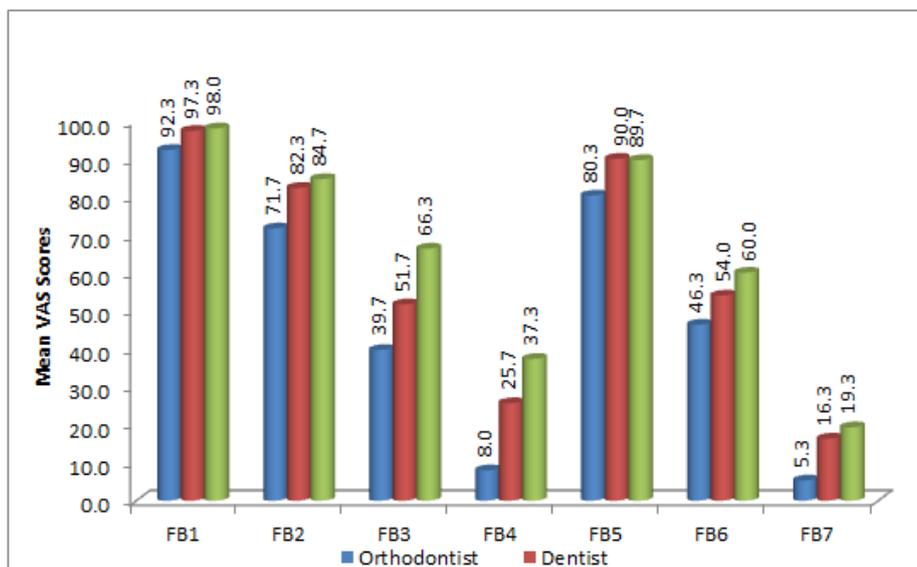**Table-6: Comparison of mean VAS scores between 03 groups for Male patient's smile face Photographs [MA1 – MA7]**

| Variable	Groups	N	Mean	SD	Std. Error	ANOVA Test		Tukey's HSD Post hoc	
						F	P-Value	Sig. Diff	P-Value
MA1	Orthodontist	30	93.7	7.2	1.3	22.306	<0.001*	O Vs D	0.02*
	Dentist	30	89.0	8.4	1.5			O Vs L	0.001*
	Layperson	30	100.0	0.0	0.0			D Vs L	<0.001*
MA2	Orthodontist	30	60.0	8.3	1.5	24.756	<0.001*	O Vs D	0.23
	Dentist	30	63.7	8.5	1.6			O Vs L	<0.001*
	Layperson	30	75.0	9.0	1.6			D Vs L	<0.001*
MA3	Orthodontist	30	31.7	7.0	1.3	24.083	<0.001*	O Vs D	0.004*
	Dentist	30	39.3	12.0	2.2			O Vs L	<0.001*
	Layperson	30	47.7	6.8	1.2			D Vs L	0.001*
MA4	Orthodontist	30	3.0	4.7	0.9	52.482	<0.001*	O Vs D	<0.001*
	Dentist	30	16.0	8.6	1.6			O Vs L	<0.001*
	Layperson	30	20.3	6.7	1.2			D Vs L	0.04*
MA5	Orthodontist	30	79.7	10.3	1.9	12.917	<0.001*	O Vs D	<0.001*
	Dentist	30	91.3	10.1	1.8			O Vs L	<0.001*
	Layperson	30	91.0	9.9	1.8			D Vs L	0.99
MA6	Orthodontist	30	45.0	9.0	1.6	44.148	<0.001*	O Vs D	<0.001*
	Dentist	30	65.0	7.8	1.4			O Vs L	<0.001*
	Layperson	30	56.7	8.0	1.5			D Vs L	0.001*
MA7	Orthodontist	30	5.0	6.3	1.2	12.100	<0.001*	O Vs D	0.003*
	Dentist	30	13.7	11.6	2.1			O Vs L	<0.001*
	Layperson	30	17.0	10.6	1.9			D Vs L	0.39
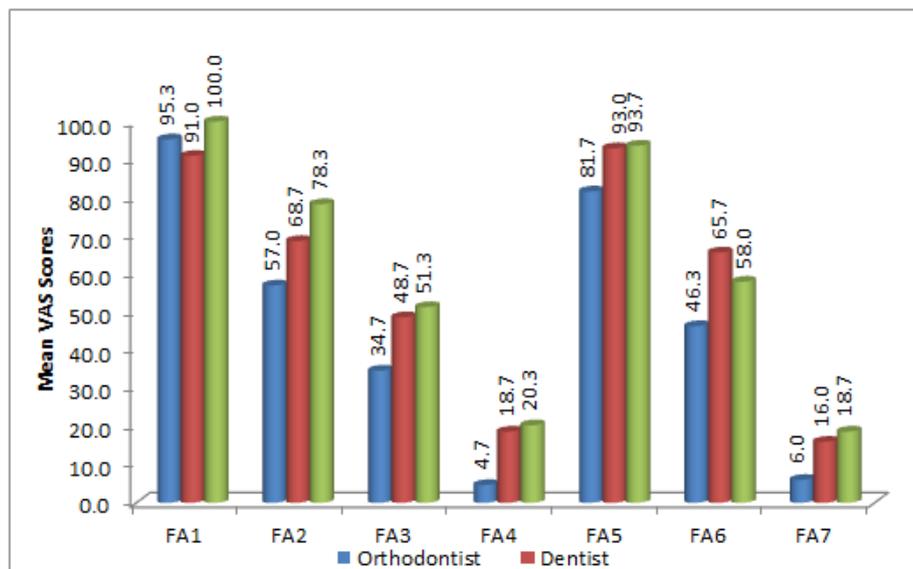
Graph-1: Comparison of mean VAS scores between 03 groups for female patient's smile face Photographs [FA1 - FA7]

Table-7: Comparison of mean VAS scores between 03 groups for Male patient's Close smile Photographs [MBI - MB7]

Variable	Groups	N	Mean	SD	Std. Error	ANOVA Test		Tukey's HSD Post hoc	
						F	P-Value	Sig. Diff	P-Value
MB1	Orthodontist	30	89.3	6.9	1.3	2.288	0.11	O Vs D	0.63
	Dentist	30	91.3	9.4	1.7			O Vs L	0.09
	Layperson	30	94.0	8.9	1.6			D Vs L	0.45
MB2	Orthodontist	30	69.3	8.3	1.5	33.806	<0.001*	O Vs D	<0.001*
	Dentist	30	82.3	7.7	1.4			O Vs L	<0.001*
	Layperson	30	84.7	7.3	1.3			D Vs L	0.48
MB3	Orthodontist	30	38.7	7.3	1.3	91.585	<0.001*	O Vs D	<0.001*
	Dentist	30	51.7	8.3	1.5			O Vs L	<0.001*
	Layperson	30	66.3	8.1	1.5			D Vs L	<0.001*
MB4	Orthodontist	30	7.0	7.0	1.3	28.024	<0.001*	O Vs D	<0.001*
	Dentist	30	22.7	7.4	1.4			O Vs L	<0.001*
	Layperson	30	28.0	16.7	3.0			D Vs L	0.17
MB5	Orthodontist	30	80.3	7.6	1.4	12.689	<0.001*	O Vs D	<0.001*
	Dentist	30	90.0	8.7	1.6			O Vs L	<0.001*
	Layperson	30	89.7	8.9	1.6			D Vs L	0.99
MB6	Orthodontist	30	46.3	7.6	1.4	16.080	<0.001*	O Vs D	0.006*
	Dentist	30	54.0	10.0	1.8			O Vs L	<0.001*
	Layperson	30	60.0	10.2	1.9			D Vs L	0.04
MB7	Orthodontist	30	5.3	5.1	0.9	17.684	<0.001*	O Vs D	<0.001*
	Dentist	30	16.3	11.6	2.1			O Vs L	<0.001*
	Layperson	30	19.3	10.7	2.0			D Vs L	0.44

Graph-2: Comparison of mean VAS scores between 03 groups for female patient's Close smile Photographs [FB1 - FB7]
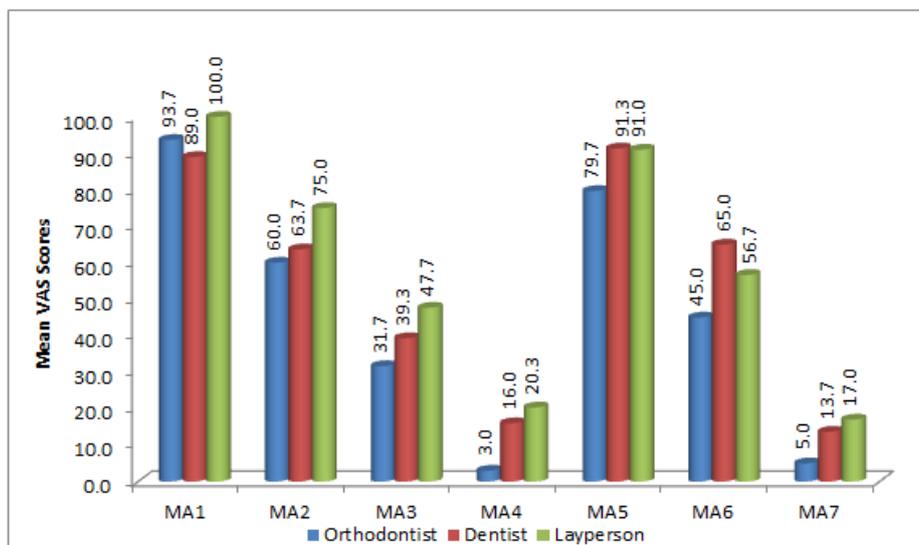
Graph-3: Comparison of mean VAS scores between 03 groups for Male patient's ' smile face Photographs [MA1 - MA7]
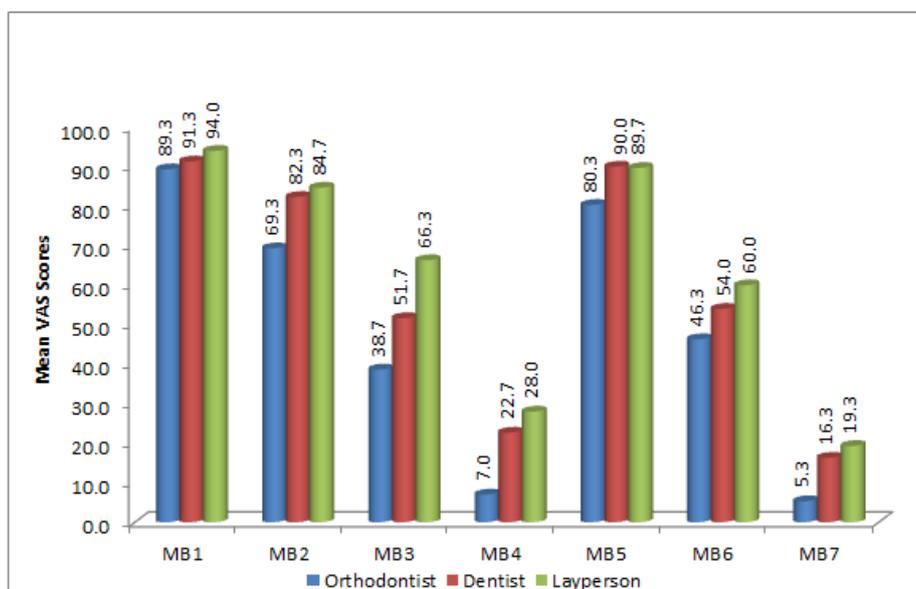
Graph-4: Comparison of mean VAS scores between 03 groups for Male patient's Close smile Photographs [MB1 - MB7]

DISCUSSION

Facial and dental esthetics plays an important role in quality of life. Esthetic concerns about the smile are often patient's main reason for seeking dental care. The re-emergence of the soft tissue paradigm in clinical orthodontics has made smile analysis a key element in diagnosis and treatment planning. Modern orthodontic therapy considers an attractive well balanced smile as a paramount treatment objective. Snow considered a bilateral analysis of apparent individual tooth width as a percentage of the total apparent width of the six anterior teeth. He proposed the golden percentage, wherein the proportional width of each tooth should be: canine 10%, lateral 15%, central 25%, central 25%, lateral 15%, and canine 10% of the total distance across the anterior

segment, in order to achieve an esthetically pleasing smile [5].

The position of the maxillary anterior teeth is a fundamental component of an attractive smile, determined through both common sense and professional evaluation. A previous study indicated that moving the maxillary anterior teeth could maximize the potential for improving a patient's smile attractiveness [54].

According to the literature, treatment of dental asymmetries is a simple procedure; depending on the location and severity of the problem, it can be accomplished by enamel reshaping, composite restorations, or porcelain veneers. After restoring the

tooth anatomy, if gingival asymmetry is still present, it can be corrected by periodontal surgery or orthodontic intrusion or extrusion complemented by composite restorations or tooth enamel reshaping [49]

Facial photographs are commonly used in socio psychological studies and judgments pertaining to photographs are shown to be fairly consistent with judgments pertaining to real people. Full facial photographs [55] and lower facial third photographs are the most commonly used framings. It appears that lower facial third photographs may allow easier control of background interferences (eg, hair contour and style, eye shape, skin tone, and complexion). As Peck and Peck reported, "We orthodontists tend to forget that facial esthetics is a subject that interests all people everywhere, and the ultimate source of esthetic values should be the people and not just ourselves [60] ".

Therefore, the purposes of present study were to evaluate the effect of the incisor edge asymmetry on aesthetic perception on frontal smile view. The methodology of the research used in present study was based on previous studies found in the literature [55-59]. in which the results of possible treatments with orthodontic intervention were evaluated by means of modifications in photographs with the use of image-editing programs. The use of image-editing computer programs that enable manipulation of the structures that compose the face allows for analysis of the degree of influence of certain morphologic structures on facial and dental esthetic composition. However, identification of the problem and the form of treatment to choose so that there is correction of the disposition of teeth, presents some complex and difficult decisions.

The results of present study indicated the difference in how the three groups evaluated the photographs. The results showed that even slight incisal discrepancy of 0.5mm betweem the maxillary central incisors was rated as unattractive by orthodontists

Machado *et al*. analysed the effect of various level of incisor edge asymmetries on the perception of smile esthetics and found a significant difference between orthodontists and laypeople. However, our results also showed that even a slight incisal discrepancy of 0.5 mm between the maxillary central incisors was rated as unattractive by laypeople and orthodontists. This finding supports the clinical assumption that symmetry between the maxillary central incisors is of paramount importance and also that these teeth are the key to evaluating smile esthetics. It is also important to consider that laypeople were sensitive in detecting dental asymmetries in our study compared with gingival asymmetries in previously published studies. Therefore, the clinician should refer orthodontic patients for restoration of uneven central incisors not only to re-establish anterior guidance and

prevent active incisor eruption, but also to optimize smile esthetics [49].

The orthodontist group was able to note the difference in both male and female smiling frontal and smiling lower facial third photographs. The orthodontists were able to differentiate the altered photograph from the original image when maxillary central and lateral incisor edge asymmetry from 0.5mm beyond for female, and male suggesting unacceptable esthetics and requires treatment.

The general dentists were able to differentiate the altered photograph from the original image when crown incisor edge asymmetry of central incisors from 0.5mm and for lateral incisors from 1mm and beyond for female, and male suggesting unacceptable esthetics and requires treatment but the rating was lesser than the orthodontists group suggesting they were less sensitive than orthodontics regarding the perception of esthetics.

The laypersons group were able to make out the differentiate the altered photograph from the original image when incisor edge asymmetry for central from 1mm beyond and for lateral 1mm and beyond for female, and male suggesting unacceptable esthetics and requires treatment and unable to differentiate the change of 0.5 mm incior edge asymmetry in both suggesting they are less sensitive regarding perception of esthetics when compared to orthodontist and dentist.

From present study, it can be shown that the orthodontist and general dentists groups perceived the change in incisor edge asymmetry in a much higher frequency than the laypersons. This has implications for the choice of the procedure to be performed. Hence, as an orthodontist, we need to consider this during treatment planning, and opt for a treatment that does not alter the esthetics and harmony of the smile.

CONCLUSION
The following conclusions were drawn from the present study
- Most attractive smiles in both types of image were those without asymmetries or with a 0.5-mm asymmetry on the lateral incisor.
- Tooth asymmetry was considered unattractive following a pattern: the greater the tooth asymmetry, the more unattractive the smile; tooth asymmetry on the central incisor was considered more unattractive than tooth asymmetry on the lateral incisor.
- For both groups of ratter's, 0.5 mm of asymmetry on the central incisor was considered unattractive, whereas the thresholds for lateral incisor discrepancies were 0.5 mm for orthodontists and 1.0 mm for laypersons.

REFERENCES

1. Van der Geld P, Oosterveld P, Van Heck G, Kuijpers-Jagtman AM. Smile attractiveness self-perception and influence on personality. Angle Orthod. 2007;77:759-65.
2. Maulik C and Nanda R. Dynamic smile analysis in young adults. Am J Orthod Dentofacial Orthop 2007;132:307-315.
3. Eli I, Bar-Tal Y, Kostovetzki I. At first glance: social meanings of dental appearance. J Public Health Dent. 2001;61:150–154.
4. Jornung J, Fardal O. Perceptions of patient's smiles: a comparison of patients and dentists' opinions. J Am Dent Assoc. 2007;138:1544–1553; quiz 1544–1613.
5. Thomaas M, Reddy R, Reddy BJ. Perception differences of altered dental esthetics by dental professionals and laypersons. Indian J Dent Res. 2011 Mar-Apr;22(2):242-7.
6. Baldwin D.C, Barnes M L. Psychological factors motivating on the timing of orthodontic Treatment. I.A.D.R. 1965;44:461.
7. Tung AW, Kiyak HA. Psychological influences on the timing of orthodontic treatment. American Journal of Orthodontics and Dentofacial Orthopedics. 1998 Jan 1;113(1):29-39.
8. Thomas J L, Hayes C, Zawaideh S. The effect of axial midline angulation on dental esthetics. Angle Orthod. 2003;73:359–364.
9. Ghaleb N, Bouserhal J, Bassil-Nasiff N. Aesthetic evaluation of profile incisor proclination. Eur J Orthod. 2011;33:228-235.
10. Kokich V. Esthetics and anterior tooth position: an orthodontic perspective part III: mediolateral relationships. J Esthet Dent. 1993;5:200–207.
11. Janzen EK. A balanced smile--a most important treatment objective. Am J Orthod. 1977;72(4):359-72.
12. Lisen V. Espeland, Cand odont. Perception of personal dental appearance in young adults: Relationship between occlusion, awareness, and satisfaction. Am J Orthod Dentofacial Orthop. 1991;100(3):234-41
13. Kovich V. Esthetics and anterior tooth position: an orthodontic perspective. Part I: Crown length. J Esthet Dent.1993;5(1):19-23.
14. Giddon DB. Orthodontic applications of psychological and perceptual studies of facial esthetics. Semin Orthod 1995;1(2):82-93
15. Birkeland K, Boe OE. Orthodontic concern among 11-year-old children and their parents compared with orthodontic treatment needassessed by index of orthodontic treatment need. Am J Orthod Dentofacial Orthop. 1996;110(2):197-205.
16. Vallittu PK, Vallittu AS. Dental aesthetic a survey of attitudes in groups of patients. J Dent 1996;24(5):335-8.
17. Beyer JW, Lindauer SJ. Evaluation of dental midline position. Semin Orthod. 1998 ;4(3):146-52.
18. Kokich VO. Comparing the perception of dentist and laypeople to altered dental esthetics. J Esthetic Dent. 199;11:311-324.
19. Johnston CD, Burden DJ, Stevenson M. The influence of dental to facial midline discrepancies on dental attractive ratings. Eur J Orthod. 1999;21:517–522.
20. Kurth JR, Kokich VG. Open gingival embrasures after orthodontic treatment in adults: prevalence and etiology. Am J Orthod Dentofacial Orthop. 2001 Aug;120(2):116-23.
21. Mugonzibwa EA, Kuijpers-Jagtman AM. Perceptions of dental attractiveness and orthodontic treatment need among Tanzanian children. Am J Orthod Dentofacial Orthop. 2004; 125(4):426-33.
22. LaVacca MI, Tarnow DP. Interdental papilla length and the Perception of aesthetics. Aesthet Dent. 2005;17(6):405-412.
23. Sabri R. The Eight Components of a Balanced Smile. J Clin Orthod 2005; 39(3):155-67.
24. Maple JR, Vig KW. A comparision of provider's and consumer's perception of attractiveness. Am J Orthod Dentofacial Orthop. 2005;128(6):690-6
25. Parekh SM, Fields HW. Attractiveness of Variations in the Smile Arc and Buccal Corridor Space as Judged by Orthodontists and Laymen. Angle Orthod 2006;76(4):557-63.
26. Soh J, Chew MT. Perceptions of dental esthetics of Asian orthodontists and laypersons. Am J Orthod Dentofacial Orthop. 2006;130:170-6.
27. Bernabe´ E, Kresevic VD. Dental Esthetic Self-perception in Young Adults with and without Previous Orthodontic Treatment. Angle Orthod 2006; 76(3):412-6.
28. Ritter DE, Gandini Lg. Analysis of the smile photograph. World J Orthod. 2006; 7(3):279-85.
29. Kokich VO, Kokich VG and Kiyak HA. Perception of dental professional and laypersons to altered dental esthetics: Asymmetry and symmetric situations. Am J Orthod Dentofacial Orthop. 2006; 130:141-151.
30. Ong E, Brown RA, Richmond S. Peer assessment of dental attractiveness. Am J Orthod Dentofacial Orthop. 2006; 130(2):163-9.
31. Van der Geld P, Oosterveld P, Van Heck G, Kuijpers-Jagtman AM. Smile attractiveness: self-perception and influence on personality. The Angle Orthodontist. 2007 Sep;77(5):759-65.