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Evaluation of Facial and Dental Symmetry Using Computer Aided Photogrammetry - An In Vivo Study.

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ABSTRACT

Facial features have an important influence in the perception of an individual's personality. Aesthetic evaluation of the oral cavity often concentrates on the color, spacing, and arrangement of the teeth. Symmetry is one of the essential components in the perception of dentofacial aesthetics. Symmetry refers to the regularity or balance of tooth arrangement and serves to define how much regularity is required and how much asymmetry is allowed in the dental composition. Use of digital photographs of the face becomes a part of the usual procedure for planning of dental aesthetic treatment. The aim of this study is to evaluate the facial and dental symmetry in the vertical and horizontal direction using digital photographs. A total number of 100 subjects were selected and divided into group 1 and group 2. Group 1 consisted of 50 subjects of 24-28 yrs. with an average age of 26 yrs. Group 2 consisted of 50 subjects of 17-21 yrs. with an average age of 19 yrs. Symmetry in VERTICAL direction: In group 1, facial and dental midline coincides in 25 of 50 subjects examined. In group 2, facial and dental midline coincides in 27 of 50 subjects examined Symmetry in HORIZONTAL direction: In group 1, parallelism between the interpupilary line and line across edges of central incisors is present in 37 of 50 subjects examined. In group 2, parallelism between the interpupilary line and line across edges of central incisors is present in 47 of 50 subjects examined. Results revealed that percentage in which facial and dental midline coincides was more in group 2 when compared to group 1. Results also showed that the percentage in which parallelism is present between the interpupilary line and line across the central incisors is more in group 2 as compared to group 1.

Keywords: facial and dental symmetry, photogrammetry

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INTRODUCTION

The dental professionals routinely have a significant role in the creation or restoration of beauty for their patients [5]. The beauty created by the dental professional affects the well-being of many patients and draws the attention of the dentist to the fact that constant updating in this field is necessary [6]. Principal focus of aesthetics in dentistry is face. Face is the most recognisable feature of the body, an innate and learned response commencing in early childhood [7]. The reason for this is the complexity of social interactions and physical attractiveness, and also because media 7 images focus mostly on the face [7]. Face reveals the physical landmark of a person's identity, and gives clue to their psychological make-up or persona. Smile, in turn, is the most recognizable feature of face. It serves as a crucial non-verbal communication tool. It is an outward expression representing a facial depiction of human emotions such as pleasure, amusement, and happiness.

Smile may be forced or spontaneous. Forced or social smile is voluntary, static, and perfectly reproducible whereas the spontaneous smile or involuntary smile cannot be reproduced as it is activated by joy and emotion. Smile photographs are standardised with a forced smile due8 to its reproducibility [8].

A smile, when symmetrical, clearly enhances the aesthetics of an individual. Symmetry is the correspondence in size, shape, and relative position of parts on opposite sides of a dividing line or median plane or about a center or axis. The dividing line, which is used to attain symmetry, is known as the midline. It is the fundamental reference for all aesthetic deviations [9].

Aim of the study

The aim of this study is to evaluate facial and dental symmetry in vertical and horizontal directions using digital photographs. The study also aims in re-evaluating the changes in facial symmetry, if any, at the end of the second year.

Objective of the study

The objectives of the study are:

- To evaluate facial and dental midline
- To evaluate the co-incidence between facial and dental midline
- To evaluate the parallelism between interpupilary line and a line across incisal edges of the incisors

MATERIALS AND METHODS

Source of Data

A total number of 100 subjects were randomly selected from The Oxford Dental College BANGALORE, INDIA. The selected subjects were divided into two groups i.e. Group 1 and Group 2.

Group 1 consisted of 50 subjects in an age group of 24-28 years with an average age of 26 years.
Group 2 consisted of 50 subjects in an age group of 17-21 years with an average age of 19 years.Subjects belonging to Group 2 were re-evaluated at the end of the second year.

Method of collection of data

A total number of 100 subjects were selected randomly from the oxford dental college.

In all the subjects, there was no significant abnormality in the stomatognathic system.

The selected subjects were evaluated according to following criterias:

- Absence of dental and facial anomalies.

- Absence of visible asymmetry of the face.
- Intact maxillary anterior teeth free of caries, restorations, crowns, veneers and noticeable abrasion of incisal edges.

However, minimal deviation in the form of rotation or inclination of some teeth were considered permissible.

Digital frontal photographs of the subjects with smile was made using digital SLR Camera (Nikon 921K-dot LCD)-14.1 Megapixels and 21X optical zoom.

Standardisation of Photographs

All subjects were photographed under the following conditions:

- The head of the subjects were positioned so that the Frankfort Horizontal Plane and the interpupilary line were parallel to the surface of the floor.
- The subjects were asked to smile; standardised with a forced smile.
- The digital camera was fixed on a tripod.
- The tripod with the camera was kept at a distance of 4 meter from the face of the subject.
- Photographs included the neck area to the top of the forehead, lenses centered between the eyes.

Symmetry of the face was evaluated in both Vertical and Horizontal direction.

Digital photographs were processed using Adobe Photoshop Cs.

Adequate software tools- Corel DRAW Graphic Suite 12- Dimension Tool and Interactive Connector Tool were used to analyse the photographs.

The symmetry of photographs was assessed by the correspondence of the facial midline with the dental midline, and parallelism of the incisal line with interpupilary line.

Symmetry of the face was evaluated in the VERTICAL direction by the following method

The midline of the face was first determined in a vertical direction. The width of the intercanthal distance and width of the philtrum were measured. The mid of the intercanthal line and mid of the width of the philtrum determined the midline of the face. Facial midline was also corresponded with the mid of the nose and mid of the chin. This determined the deviation of the nose and chin. Dental midline was determined by the Interincisal line, which is the line drawn between the central incisors. The facial midline was analysed and compared with the dental midline.

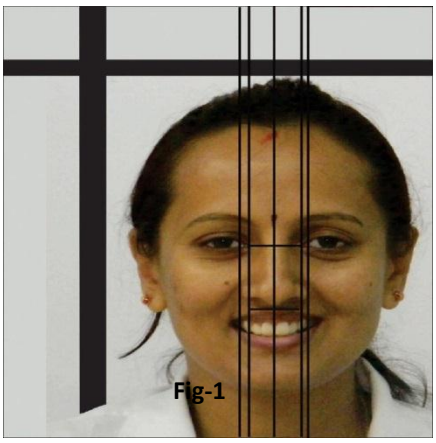

Fig-1

Symmetry of face was evaluated in the HORIZONTAL direction by following method

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A horizontal line was drawn from the center of one pupil to the center of the other pupil. Another horizontal line was drawn along the incisal edges of the central incisors. Parallelism between these two lines were then evaluated to check the symmetry in horizontal direction.

Fig-2

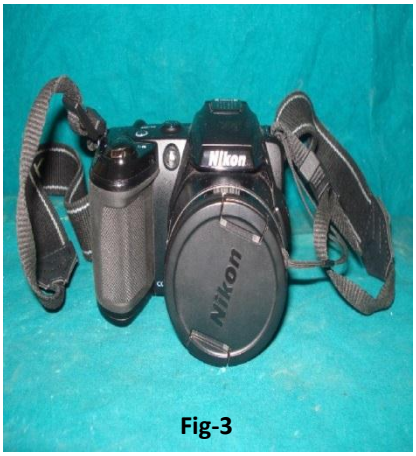

Fig-3

DIGITAL SLR CAMERA (NIKON 921K-DOT LCD)-14.1 MEGAPIXELS 21X OPTICAL ZOOM

Fig-4

Fig-4

THE TRIPOD

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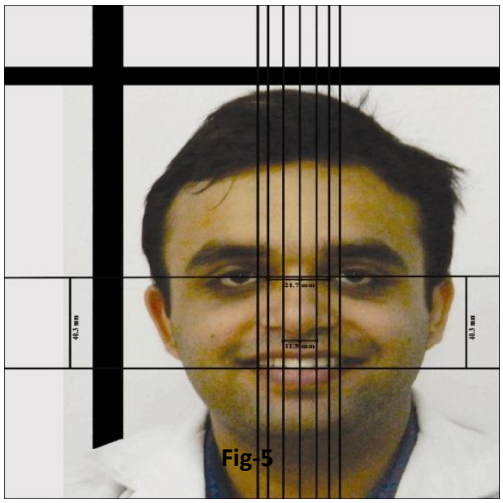

Fig-5

Photograph of a subject belonging to group 1, where facial midline coincides with dental midline and parallelism is present.Between the interpupilary line and line across edges of central incisors

Fig-6

Photograph of a subject belonging to group 1, where facial Midline does not coincide with dental midline but parallelism is Present between the interpupilary line and line across edges of Central incisors

RESULTS

In the present study, a total number of 100 examinees were randomly selected from The oxford Dental College, Bangalore. Selected subjects were divided into two groups- Group 1 and Group 2.

Group 1 consisted of 50 examinees in an age group of 24-28 years with an average age of 26 years.
Group 2 consisted of 50 examinees in an age group of 17-21 years with an average age of 19 years.
Symmetry of the face was evaluated in horizontal and vertical direction for all the 100 subjects.
Subjects belonging to group 2 were re-evaluated at the end of the second year.

Table 1: Distribution of study subjects by groups

Group	Age groups	Mean age	No of subjects
Group 1	24-28yrs	26yrs	50.0
Group 2	17-21yrs	19yrs	50.0

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This table-1 shows the distribution of subjects depending on age groups. Group1 subjects belonged to an age group of 24-28 years and Group 2 subjects belonged to an age group of 17-21 years. Equal number of subjects were selected for both the groups.

Table 2:Comparison of group 1 and group 2 with respect to symmetry of face in horizontal and vertical direction

Observations	Group 1	%	Group 2	%	Z-value	P-value
Presence of coincidence between facial & dental midline	25	50.00	27	54.00	- 0.4003	0.6889
Absence of coincidence between facial and dental midline	25	50.00	23	46.00	0.4003	0.6889
Absence of coincidence between facial and dental midline	37	74.0	47	94.00	-2.7277	0.0064*
Absence of parallelism between interpupilary line and line across edges of central incisors	13	26.0	3	6.00	2.7277	0.0064*
Chi-square= 4.271.1 P = 0.2341						

*p<0.05

The above table-2 also shows the comparison between the results of group 1 and group 2.

The only significant parameter in comparison of results of group 1 and group 2 is the parallelism between the interpupilary line and line across edges of central incisors as the value is less than 0.05. (p<0.05).

Re-evaluation of GROUP 2 did not show any difference in results- **Table -3**

Observations	Group 2	%
Presence of coincidence between facial & dental midline	27	54.00
Absence of coincidence between facial and dental midline	23	46.00
Presence of parallelism between interpupilary line and line across edges of central incisors	47	94.00
Absence of parallelism between interpupilary line and line across edges of central incisors	3	6.00

VERTICAL DENTAL SYMMETRY

The results show that in group 1, facial and dental midline coincides in 25 of 50 subjects examined. In group 2, facial and dental midline coincides in 27 of 50 subjects examined.

HORIZONTAL DENTAL SYMMETRY

The results show that in group 1, parallelism between the interpupilary line and line across edges of central incisors is present in 37 of 50 subjects examined. In group 2, parallelism between the interpupilary line and line across edges of central incisors is present in 47 of 50 subjects examined.

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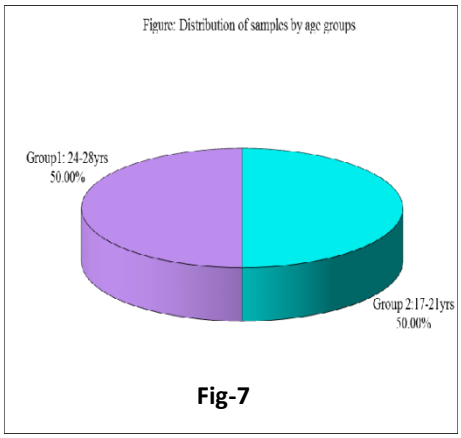

Fig-7

This figure-7 shows the distribution of samples ccording to age groups. Subjects belonging to group 1 of age group 24-28 years contribute to 50% of the total sample. Subjects belonging to group 2 of age group 17-21 years contribute to 50% of total sample

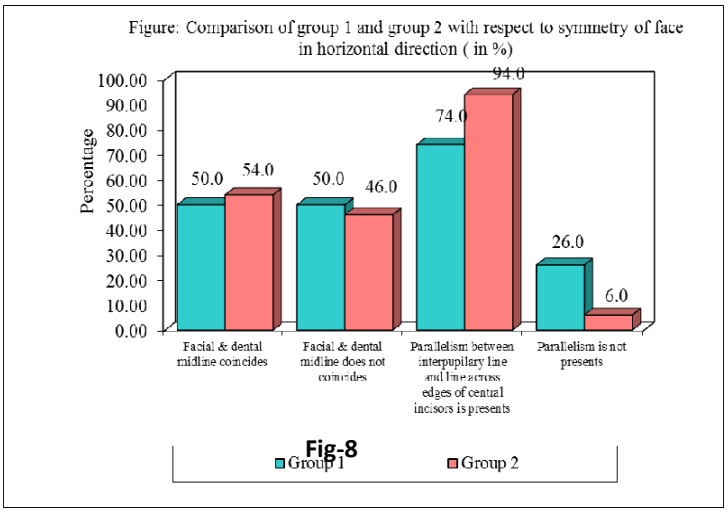

Fig-8

The Fig-8 bar graph above shows the comparison of group 1 and group 2 with respect to symmetry of face in vertical as well horizontal direction. This shows that facial and dental midline coincides in 50% of subjects of group 1 and in 54% of subjects of group 2.

Parallelism is present between the interpupilary line and line across edges of central incisors in 74% subjects of group 1 and in 94% subjects of group 2.

DISCUSSION

Aesthetics is of absolute importance in the practice of modern dentistry and is synonymous with a natural, harmonious appearance. The facial features have an important influence in the perception of an individual's personality.

An attractive smile further enhances the personality of the individual. For a pleasing smile, the facial midline must be closer to the dental midline. The further away from the dental midline, more asymmetrical the smile may be.

Symmetry is one of the essential components in the perception of dentofacial aesthetics.

Symmetry refers to the regularity or balance of tooth arrangement and serves to define how much regularity is required and how much asymmetry is allowed in the dental composition. Harmonious facial features are more symmetrical when close to the facial midline and asymmetrical when away from the facial midline.

Proper location of the dental midline is necessary for the stability of the dental composition, as improper placement of the midline makes it impossible to balance the elements on either side of it [18].

Use of digital photographs of the face has become a part of the usual procedure in the planning of dental aesthetic treatment. Digital photographs have been considered as a reliable method to evaluate the facial and dental symmetry in horizontal as well as vertical direction. Photographs create a more comprehensive virtual model of the patient, which facilitates the creation of prosthetic work that more concisely blends with the biology and esthetics of the patient, as opposed to only information obtained from stone models and lab prescription [16].

In the present study, evaluation of the vertical and horizontal symmetry was done with help of photographs. Categorization of the photographs was done by using the computer program Corel Draw and they were then processed using Corel Draw Graphic Suite 12. On the digital photographs, dimension and interactive tools were used to draw the lines selected for the evaluation of horizontal and vertical symmetry.

In this study, a total number of 100 subjects were selected randomly from The Oxford Dental College, Bangalore to evaluate the facial and dental symmetry in vertical as well as horizontal direction, and its contribution in enhancing the aesthetics of the patient in different age groups. Group 1 consisted of 50 subjects in an age group of 24-28 years with an average age of 26 years. Group 2 consisted of 50 subjects in an age group of 17-21 years with an average age of 19 years. Group 2 was re-evaluated at the end of the second year to evaluate the effect of time on the symmetry. The younger age group i.e. group 2 was re-evaluated for changes, if any, occurring due to growth.

In the present study, facial midline was determined by joining the midpoint of the intercanthal line and the midpoint of the width of the philtrum. It was then evaluated for its co-incidence with the dental symmetry.

Studies by Seki et al proved that the medial angle of the eye is one of the most reliable feature in determining the facial midline. They stated that the absolute separation between the dental midline and a line drawn from the midpoint between the median angles of the eyes was 20 only 0.1mm on an average.[20]

According to study by Jeff et al, the starting point of the aesthetic treatment plan is the facial midline. A practical approach in locating the facial midline refers two anatomical landmarks. The first is a point between the brows known as the nasion. The second is the base of the philtrum, also referred to as the cupid's bow in the center of the upper lip. A line drawn between these landmarks not only locates the position of the facial midline but also determines the direction of the midline [12].

Survey done by Miller et al utilized the midline of philtrum as the midline of the face and considered it the most reliable guide for the same. 70% of their subjects had maxillary dental midlines that coincided with the midline of the philtrum [19].

The additional vertical lines were taken into consideration in the present study to evaluate symmetry furthermore. The lines taken were vertical line drawn across the inner canthus of the eye and the vertical line drawn across the ala of the nose. These lines were taken so as to assess its co-relation with the facial symmetry.

The results of the present study show that the percentage of coincidence of facial and dental midline in group 1 is 50%. Studies by Al Wazzan et al concluded that dental and facial midlines coincided with each other in 58.26% of Saudi patients [17].

According to Miller and coworkers, the dental midline coincided with the facial midline in 19 70.4% of the subjects [19]. Soares et al found the coincidence between the facial and dental midline in 65% Brasilian 1 subjects [1].

The coincidence of facial, maxillary, and mandibular midlines is desirable, but not mandated. A mild degree of facial asymmetry commonly occurs in individuals and is barely recognized 11 by the general public [11].

The results also show that the percentage of coincidence of facial and dental midline in group 2 is 54%, which was re-evaluated at the end of the second year. Subjects belonging to group 2, when re-evaluated at the end of the second year also proved the coincidence between the facial and dental midline to be 54%, which means that the results did not show any difference even after re-evaluation.

Results of the present study did show mild disrepency. Mild discrepancy, if seen between the facial and dental midline, however, cannot be perceived by general population.

Previous study by Vincent et al showed that the dentist's ability to diagnose asymmetry clinically was more when compared to the laypersons [13].

Previous study by Amra et al showed that the deviations < 1.7mm are clinically difficult to 1 notice. These results are in accordance with the present study [1].

A differing view suggested that the positioning of the dental midline exactly over the facial midline can contribute to artificiality. So, a small discrepancy of about 1.5-2mm is acceptable, giving a natural appearance to dentition [8].

Facial symmetry in horizontal direction was determined by evaluating parallelism between the interpupilary line and line across the edges of central incisors.

According to Ahmad et al, the parallelism between the interpupilary line and a line across the incisal plane is the most reliable criteria to check symmetry in horizontal direction. He stated that these parallel lines create horizontal symmetry and act as cohesive forces unifying the facial composition. He also stated that the facial midline is perpendicular to the horizontal lines and opposes their cohesiveness. These are termed as segregative forces and are essential 7in a composition to give it interest and harmony [7].

Evania et al considered the interpupilary line as one of the most striking parameter in evaluating symmetry. They stated that the interpupilary distance and its relationship with other anatomic structures can be used as a reference in treatments, but measurements must be assessed individually [14].

In the present study, results show the presence of parallelism between a line across the center of the pupil of the eyes and a line across the edges of the central incisors is 74% in group 1 and 94% in group 2.

According to Ahmad et al, the general parallelism between the horizontal lines is important as opposed to the orientation of one single line. He also used interpupillary line as a reference for the occlusal and incisal plane orientations. His study also concluded that the other horizontal lines do not act as definitive references and are useful accessory markers.

The subjects belonging to group 2 were re-evaluated at the end of the second year. This was done to examine the differences in symmetry that might occur over a period of time in younger age group. It could occur because of various reasons such as growing age, stress or
the habits.

However, in the present study, results obtained from re-evaluation of the subjects belonging to group 2 did not show any difference in any of the parameters evaluated. This shows that a small period of time does not cause any change in the symmetry in the younger age group. George H. Latta stated that neither the facial nor the anatomic measurements changed significantly with age. However, there were differences between races and between sexes, and a definite correlation was seen between philtrum size and mouth size even when age, sex and race were discounted [24].

In the present study, a significant difference ($p<0.05$) was found only in relation to the symmetry in the horizontal direction. Results obtained could not be related to any probable determinants because the subjects selected were of younger age groups and the time period of re-evaluation was of shorter duration. The role of soft tissues undergoing changes as age advances remains questionable. Hence, further studies need to be done to support the same.

Limitations of the study

The present study did not review cephalometric lines and angular measurements.Hence, definitive cephalometric landmarks should be considered in future for Evaluating the facial and dental symmetry. The present study did not categorize the subjects depending upon sex and race of the General population. Therefore, in further studies, the general population should be Divided depending upon their sex and race. visual errors and discrepancies can occur during transfer of measurements on the Photographs. un-intentional change in the posture can also lead to faulty results. Long term study on a larger population can be undertaken to obtain definitive results.

CONCLUSION

This study evaluated the facial and dental symmetry in both horizontal and vertical direction using digital photographs. The selected subjects were divided into two groups i.e. group 1 and group 2.

Within the limitations of the study, the following conclusions were drawn:

1. Facial and dental midline coincides in 50% of individuals belonging to group 1 and in 54% of individuals belonging to group 2.
2. Parallelism between interpupilary line and line across edges of central incisors was resent in 37% of individuals belonging to group 1 and in 47% of individuals belonging to group 2.
3. Re-evaluation of subjects belonging to group 2 did not show any difference in the results obtained earlier.

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