

“Smile – A Diagnostic Tool: Photographic analysis in Adult Gujarati Population”

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Abstract: Smile analysis forms an important component of the frontal facial assessment. Analysing the smile and obtaining averages for various smile components give an idea about a standard of normalcy to serve as a guideline for the creation of esthetic smile.

Material & Methods : This cross-sectional study was undertaken to analyse smile in Gujarati population. Frontal view photographs of 100 subjects distributed equally in to 50 males and 50 females were taken from government dental college & hospital, Ahmedabad, Gujarat.

Results : More percentage of females showed consonant smile arc and high anterior smile line than their counterparts in this study. No statistically significant correlation was found between anterior smile height, posterior smile height, smile curve & buccal corridor width in males and females.

Key Words: Smile analysis, Smile index, Smile height, Smile curve, Buccal corridor width.

I. Introduction

Esthetic, which is derived from the Greek word for “perception”, deals with beauty and beautiful. It has two dimensions: Objective and Subjective.¹³ Objective (admirable) beauty is based on consideration of the object itself, implying that the object possesses properties that make it undoubtedly praiseworthy. Subjective (enjoyable) beauty is a quality that is value-laden, relative to the tastes of the person contemplating it.^{13, 14} A holistic approach to orthodontic practice would not be only to treat the malocclusion of teeth, but also to deal with faces of individuals that influence the person’s bearing and wellbeing.¹⁹ The early concept of esthetics revolved largely around the patient’s profile, and it was believed that once the ideal tooth jaw positions were achieved, then the soft tissues would fall in line. Now the frontal assessment is given as much importance as the profile evaluation. Smile analysis forms an important component of the frontal facial assessment.¹¹

The smile is one of the most effective means by which people convey their emotions and it is viewed frontally more often than in profile. The smile is rightfully considered a valuable tool of nonverbal social communication, a civilized form of human contact, and a sound criterion of facial attractiveness. Research suggests that we trust smiling people more than non smiling ones. There are two forms of smiles- the enjoyment or Duchenne smile, and the posed or social smile.⁷ Posed smiles gained importance in dentistry and orthodontics mainly because they are repeatable over time.² Orthodontic diagnosis has come a long way and now includes patient-driven esthetic diagnosis and treatment planning along with its problem oriented approach. The reemergence of the soft-tissue paradigm in clinical orthodontics has made smile analysis, a key element in diagnosis and treatment planning along with cephalometry and study models.¹¹ Much attention is given in clinical examination to the display zone of smile, which is determined by intercommissural width, interlabial gap, smile index, display of gingiva, smile arc.¹¹

Analyzing the smile and obtaining averages for various smile components give an idea about a standard of normalcy to serve as a guideline for the creation of an esthetic smile. Therefore, this study was undertaken to measure and establishment of different smile components that help in establishment of beautiful smile.

II. Aims And Objectives

- ❖ To compare smile arcs for consonance and non consonance in males and females.
 - ❖ To calculate the smile index in males and females.
 - ❖ To compare smile index between males and females.
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- ❖ To evaluate and compare anterior and posterior smile height (malesvs females).
- ❖ To evaluate and compare buccal corridor space (malesvs females) in the whole sample.

III. Materials And Methods

The present study is a cross-sectional study undertaken to analyze smile in Gujarati population. Frontal view photographs of 100 subjects, distributed equally into 50 males and 50 females, were taken. They were students of Government Dental College and Hospital, Ahmedabad. They were in the age group of 18 to 27 years. **Following inclusion criterias were strictly followed:**

- They were Gujaratis
- They were in the age group of 18-27 years.
- Pleasing soft tissue drape and good lip competence.
- No gross developmental aberrations of the head and face with straightprofile.
- No previous orthodontic treatmentor maxillofacial surgery.
- Complete permanent dentition except third molars with no missing or supernumerary teeth.
- Molars and canines are in Angle’s class I
- No spacing, no crowding
- No canting of the maxillary occlusal plane.

Each Subject’s consent was taken before taking the frontal view photographs.

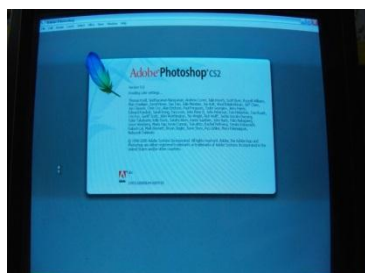
IV. Armamentarium

- Nikon D-40 X digital camera with 18-55mm optical zoom.
- Adobe Photoshop cs2, version 9.

V. Method For Obtaining Images

The subjects were photographed with posed smiles (because posed smiles are the most repeatable) after seating them in a Natural Head Position. Pictures were taken in the same environment with the same lighting conditions by using Nikon D-40 X Digital Camera. The camera was fixed in position with a tripod maintaining 2 feet distance from the subject. The lens was positioned parallel to the true perpendicular of the face and the camera was raised to the level of the patient’s lower facial third. Apart from built in flash of the camera, umbrella flashes were also used for illumination of the subject. Because not all subjects have individually repeatable smiles, three smile images of each subject were taken and the most natural or representative smile for the application of the smile analysis was selected. The photographs then transferred to Adobe Photoshop cs2 software, version 9. The ruler in the same software was used to obtain all measurements for this study.

PHOTOGRAPHIC SET UP USED FOR THE STUDY



ADOBE PHOTOSHOP SOFTWARE



DIGITAL CAMERA

V. Observation And Results

Once the images were obtained , the following criteria were evaluated :

SMILE ARC³

SMILE INDEX

ANTERIOR SMILE HEIGHT¹¹

POSTERIOR SMILE HEIGHT⁴

BUCCAL CORRIDOR PERCENTAGE⁴

For Smile arc, anterior smile height and posterior smile height frequencies were reported. They were compared between males and females.

Mean value of smile index for the entire sample group was found along with mean values for males and females. Smile index values were compared between males and females.

Buccal corridor percentage average and standard deviation for the entire sample and for males and females were obtained. They were compared between males and females.

To test the statistical significance of the difference in anterior smile height, posterior smile height and smile arc between male and female subjects, Pearson chi-square test was used. The independent-sample t test was used to test the statistical significance of the difference in buccal corridor width between males and females. The independent-sample test was also used to compare the smile index between males and females.

All the statistical analysis was done using “SPSS Version 12” software

The results of the present study are as follows:

SMILE ARC

It is the relationship between the curvature of the incisal edges of the maxillary anterior teeth and the curvature of upper border of the lower lip. The result of our study revealed, Female subjects had 72% and male subjects had 62 % of consonant smile arc. More number of female subjects showed consonant smile compare to males nevertheless the difference was not statistically significant (p= 0.288)

TABLE NO. 1

	FEMALES	MALES	P VALUE
CONSONANT	36	31	0.288
FLAT	14	19	
TOTAL NO	50	50	

SMILE INDEX

Smile index describes the area framed by the vermilion borders of the lips during the social smile. The smile index for the entire sample was 6.0212 mm. The results showed statistically no significant difference in smile index for males and females (p= 0.860). Mean values, standard deviation for smile index in males and females are given in table no.2.

TABLE NO.2 Mean and standard deviation for smile index

SMILE INDEX	MALES	FEMALES
No	50	50
MEAN	6.0582 mm	5.9842 mm
STANDARD DEVIATION	2.06056 mm	2.12372 mm
Significance (p)	.860	

ANTERIOR SMILE HEIGHT (ASH)

Out of 50 Females, (40%) of subjects had high anterior smile heights compare to males (14%). 46% of males showed average anterior smile height where as 40% males showed low anterior smile height. The difference in anterior smile height in females and males was **statistically significant (p = .012)**

TABLE NO.3

	HIGH	AVERAGE	LOW
FEMALES	20	18	12
MALES	7	23	20
SIGNIFICANCE p value	0.012		

POSTERIOR SMILE HEIGHT (PSH)

Males (42%) and females (50%) both had a larger percentage of subjects showing average posterior smile height. The difference in posterior smile height between males and females was not statistically significant. Frequencies for posterior smile height is given in table no. 3.

TABLE NO. 4

	HIGH	AVERAGE	LOW
FEMALES	21	25	4
MALES	21	21	8
SIGNIFICANCE p value	.431		

BUCCAL CORRIDOR PERCENTAGE

The average buccal corridor width for the entire sample was 14.66 % (SD 3.731 %, range 8% - 34%). The average buccal corridor width for the males (no=50) was 14.14 % and for the females was 15.18 %. Difference of buccal corridor width between males and females was not statistically significant (p .165). The independent t-test was used to determine statistical significance.

CORRELATION OF SMILE PARAMETERS IN MALES AND FEMALES

SR NO	SEX	CORRELATION BETWEEN ANTERIOR SMILE HEIGHT AND POSTERIOR SMILE HEIGHT	CORRELATION BETWEEN ANTERIOR SMILE HEIGHT AND SMILE CURVE	CORRELATION BETWEEN POSTERIOR SMILE HEIGHT AND SMILE CURVE
		“r”	“r”	“r”
1	FEMALES	0.588	0.127	-0.017
2	MALES	0.577	0.138	-0.003

Interpretation of “r” values

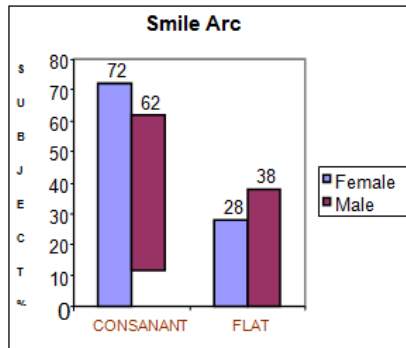
- if r = 0, no Correlation
- r<0.3, weak correlation
- 0.3<r<0.7, moderate correlation
- r>0.7, strong correlation
- r>0.9, very strong correlation
- r= +1 perfect positive correlation
- r= -1 perfect inverse correlation.

Moderate correlation exists between anterior smile height and posterior smile height in both males(r= 0.577) and females(r=0.588)

Weak correlation exists between anterior smile height and smile curve.

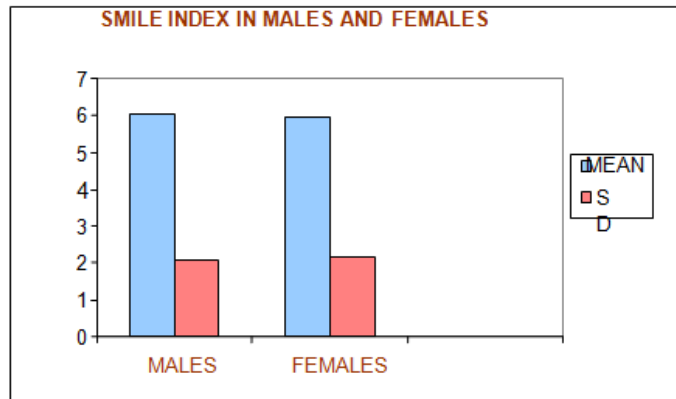
There is no correlation exists between posterior smile height and smile curve.

GENDER DIFFERENCES IN SMILE ARC



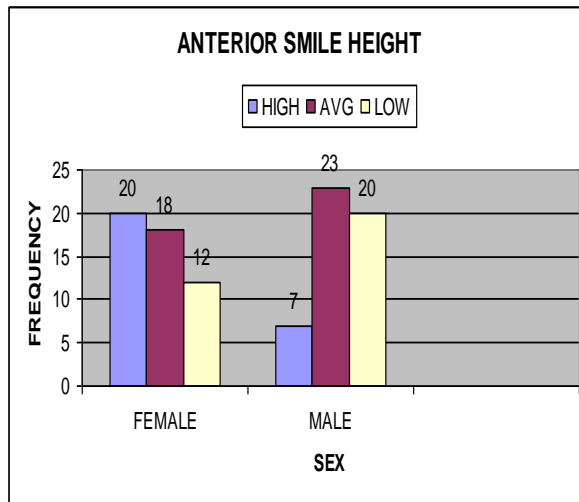
GRAPH NO 1

SMILE INDEX IN MALES AND FEMALES WITH MEAN VALUE AND STANDARD DEVIATION



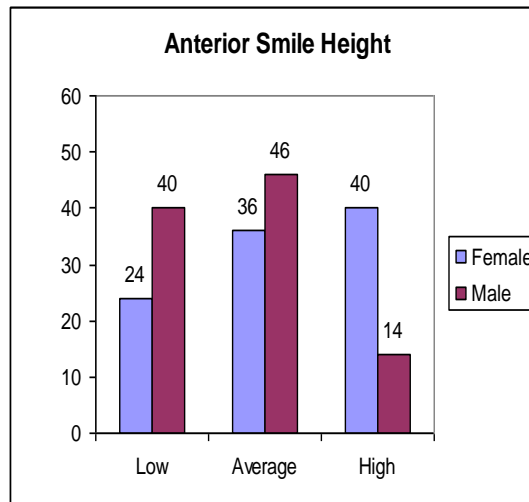
GRAPH NO 2

FREQUENCY DISTRIBUTION OF ANTERIOR SMILE HEIGHT IN MALES AND FEMALES



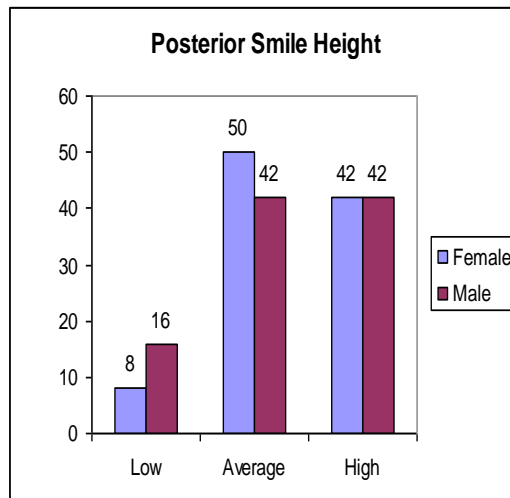
GRAPH NO 3

GENDER DIFFERENCES IN ANTERIOR SMILE HEIGHT



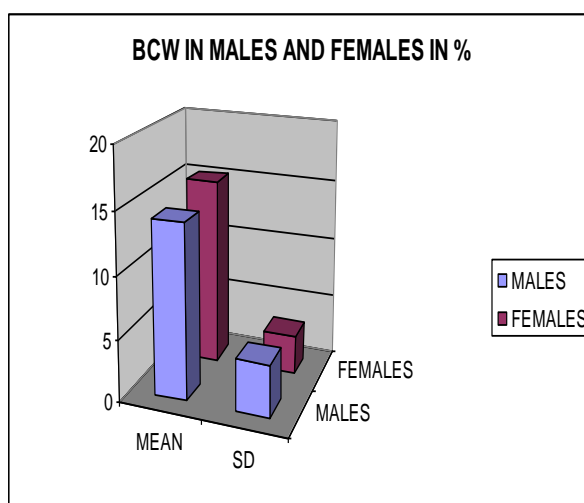
GRAPH NO 4

GENDER DIFFERENCES IN POSTERIOR SMILE HEIGHT



GRAPH NO 5

BUCCAL CORRIDOR WIDTH IN MALES AND FEMALES



GRAPH NO 6

VI. Discussion

- Smile, defined as a facial expression characterized by upward curving of the corners of the mouth, is often used to indicate pleasure, amusement, or derision¹⁷. There are two basic types of smile: 1) Dynamic smile and 2) Static smile.
- Dynamic or Enjoyment or Unposed smile are involuntary and is induced by joy or mirth. An unposed smile is natural in that it expresses authentic human emotion.
- Static or Social or Posed smile is voluntary and is not elicited or accompanied by emotions. A posed smile is static in the sense that it can be sustained. If the smile is typical for a particular individual, a posed smile is natural, but the smile also can be “forced” to mimic an unposed smile. In the latter circumstance, the smile cannot be sustained and will seem to be strained and unnatural. In the Peck classification¹⁶, a stage II smile is a “forced” or strained posed smile resulting in maximal upper lip elevation. Thus two types of posed smiles are possible: strained and unstrained. When a person is asked to pose for a photograph, the smile that is desired is a voluntary, unstrained, static, yet natural smile. Posed smiles gain importance in dentistry and orthodontics mainly because they are repeatable over time³.
- An attractive, well balanced smile is a paramount treatment objective of modern orthodontic therapy and along with cephalometry and study models smile analysis plays an equal and integral part of contemporary orthodontic diagnosis and treatment planning.
- The establishment of norms is important in orthodontic diagnoses and treatment planning. This study is done to provide norms for smile index, anterior smile height, posterior smile height, smile arc parallelism in Gujarati population aged 18 to 27 years. In this study norms also have been obtained for the buccal corridor width for Gujarati population. Traditionally, norms established in orthodontics have focused heavily on profiles and the use of lateral cephalometric radiograph.
- In this study, consonance and non- consonance in the smile arc relationship was evaluated. It is well known that a consonant smile arc is more attractive than a non consonant smile arc.^{5,7} We found more women (72%) with consonant smile arc than males 62%. Thus, female smiles seem to be more attractive and consonant than male smiles. Tjanet al¹ and Dong et al⁹, who both found the parallel smile arc to be the most frequent in their subjects. Our report of more consonant smile arcs present than non consonant smile arcs support both of these studies. We have not found any correlation between smile arc and anterior smile height and between smile arc and posterior smile arc.
- Mean Smile Index values for males and females in this study are 6.0582 mm and 5.9842 mm respectively. The mean value of smile index for the entire sample is 6.0212 mm ranging 3.46 mm- 15.93 mm These values are comparable to study done by Marc B. Ackerman et al.¹² In their study mean Smile Index value for boys is 6.04 and for girls 6.29. This high smile index values are because of the commisures of the lips move 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.
- Our results for anterior smile height show 41% of subjects with average anterior smile height. Females (40%) show larger percentage of higher anterior smile height than males (14%) and this difference is statistically significant. Peck and Peck¹⁶ established that females display higher anterior smile line than

males. Our results support theirs. The other studies that provide averages for several smile components are those by Tjanet al¹ and Dong et al⁹. Both studies have used static photographs. Tjanet al¹ and Dong et al⁹ both reported that most patients (68.9% and 56%, respectively) had average anterior smile height. The difference may be because of ethnicity. Even recently Christopher Maulik and Ravindra Nanda⁴ reported 56.9% average anterior smile height. They had used dynamic smile analysis. The difference between our results and their results may be because of methods used.

- Christopher Maulik and Ravindra Nanda⁴ were the first to give norms for posterior smile height. They used dynamic smile analysis and found more subjects with high posterior smile height. In our study, 46% subjects had average posterior smile height compare to high (42%) and low (12%). The difference for the posterior smile height in our study and study done by Christopher Maulik and Ravindra Nanda may be because of the method used to assess the posterior smile height. According to Peck and Peck¹⁶ the smile is formed in two stages. The first stage raises the upper lip to the nasolabial fold by contraction of the levator muscles originating in the fold and inserting at the upper lip. The medial muscle bundles raise the lip at the anterior teeth and the lateral muscle groups raise the lip at the posterior teeth. The lip then meets the resistance at the nasolabial fold because of the cheek fat. The second stage involved further rising superiorly of the lip and the fold by the three muscle groups: (1) the levatorlabii superior muscles of the upper lip, originating at the infraorbital region, (2) the zygomaticus major muscles and (3) superior fibers of the buccinator. Unposed smile causes maximal contraction of the elevator muscles and hence, more gingival display.
- In the study by Moore et al,²¹ buccal corridor was represented as a percentage of total smile width, the same definition used in our study. By trial and error, those authors developed and defined a range of buccal corridors and described them by the corresponding smile fullness. They defined buccal corridors of 28% as medium-narrow, 15% as medium, 10% as medium broad, and 2% as broad smile fullness. We found an average of 14% buccal corridor for the entire sample ; this falls between medium and medium – broad smile fullness as defined by Moore et al.²¹ those authors defined patients with narrow smile fullness as those with 28% buccal corridor. We found the largest buccal corridor to be 34% at the opposite end of the spectrum; Moore et al²¹ defined patients with broad smile fullness as those who exhibited 2% buccal corridor. We found 8% is the upper limit. The results of our study did not indicate statistically significant difference in buccal corridor width between males and females.

Whenever we examine a patient, we should keep in mind not to alter the positive elements of smile present in the patient.

The bracket positions should be altered according to the smile arc of the patient. For example, in a reverse smile arc, the brackets should be positioned higher than usual on the maxillary central incisors and progressively lower on the lateral incisors and canines.

An upward cant of the maxillary occlusal plane will result in a non consonant smile arc. Therefore, we should be cautious in using extraoral forces and intermaxillary elastics. While planning orthognathic surgeries, care is needed not to alter the parallelism between the incisal edges of upper teeth and border of lower lip. Over intrusion of maxillary incisors may flatten the smile arc, if the lower lip position is not kept in mind.

Arch form affects transverse dimension of the smile. A broad arch is more likely to fill the buccal corridors than narrow and constricted arch. In addition, buccal corridors are heavily influenced by the anteroposterior position of the maxilla relative to the lip drape. Moving the maxilla forward will reduce the negative space, because a wider portion of the arch will come forward to fill the inter commisure space.⁶

A different treatment philosophy is needed for patients with high lip lines than for those with average or low smile types. Active maxillary incisor intrusion should be the goal in this category of patients. Treatment alternatives include various combinations of orthodontic, periodontal, and surgical therapy.¹⁶

Intrusion base arches or utility arches may succeed in reducing a gummy smile orthodontically in some cases. Such treatment can produce a remarkable change in facial appearance. Selective intrusive and restorative techniques can also be used to improve the final esthetic result in patients with fractured or over erupted and abraded incisors.

VII. Summary and Conclusions

The concept of the smile esthetics is not a new one, as the literature review has shown. Clearly its impact on the final facial and smile appearance can be quite dramatic. Smile analysis and smile design generally involve a compromise between two factors that are often contradictory:

- The esthetic desires of the patient and orthodontist and
- The patient’s anatomic and physiologic limitations.

This demands that we rethink some of our orthodontic mechanics and concepts of treatment to consistently build this factor into our diagnostics, treatment planning and treatment regimens.

Present study involved 100 subjects. The subjects were divided into 2 equal groups of male and female. They had straight profile with molars and canines in class I occlusion. This study was conducted in an attempt to obtain norms for the various components of the smile in Gujarati population. We found that, on smiling:

- ❖ More females (72%) than males (62%) have consonant smile.
- ❖ There is no statistical difference in smile index between males and females.
- ❖ Females showed high anterior smile height more than males. The difference is statistically significant.
- ❖ More number of males and females showed average posterior smile height compare to low and high posterior smile height.
- ❖ There is no statistically significant correlation found between anterior smile height, posterior smile height and smile curve in males and females.
- ❖ There is no statistical significant difference found in buccal corridor width between males and females.

Further investigations in the same ethnic group should be carried out to substantiate the results obtained in the present study to establish standard reference norms for Gujarati population.

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