

EVALUATION AND ASSESSMENT OF THE INTERRELATIONSHIP BETWEEN MAXILLARY INCISAL CURVATURE AND LOWER LIP IN YOUNG DENTATE INDIVIDUALS IN KHEDA DISTRICT, GUJARAT: A PROSPECTIVE STUDY

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ABSTRACT

Background:

Smile is an element that affects the psychosocial well-being. Attractive smile is related to the curvature of maxillary anterior teeth to the lower lip. Smile type is related to visibility of gingiva while smiling. Smile arc is defined as the curvature formed between maxillary anterior teeth and lower lip. These parameters are important for treatment planning in dentistry.

Aim:

To evaluate smile characteristics and to assess the relationship between the maxillary anteriors and the lower lip using digital means

Study Setting and Design:

A cross-sectional observational study was conducted on 100 young dentate participants from the Kheda–Nadiad region of Gujarat, India at Dharmsinh Desai University, Faculty of Dental Science.

Materials and Methods:

Simple random sampling was done and participant of age group between 18-25 were selected. Using a Canon EOS R100 digital camera smile photographs were taken at a fixed distance of 4 feet under natural light and with proper standardization. Custom-fabricated chin-support stand was used for head support. Photos were analyzed by Adobe Photoshop version 27.2.0. Smile type is divided into high, average and low. Smile arc is classified into parallel, straight or reverse.

Results:

Out of 100 participants, it was observed that 44 (44%) had an average smile, while 28 (28%) each had high and low smiles. 62 (62%) showed parallel smile arc, 36 (36%) showed straight, and a reverse relationship in 2 (2%). A parallel arc was observed in 64.29% of high smiles, 59.09% of average smiles and 64.29% of low smiles. Smile type and smile arc are not statistically associated. ($\chi^2=2.65$, $P=0.63$).

Conclusion:

It was concluded that average smile type and parallel smile arc are most commonly seen in these participants. Statistically there is no relation between smile type and smile arc. Which states that both parameter are independent and should be considered separately.

Keywords: Young dentate, smile arc, smile type, aesthetic smile.

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INTRODUCTION

Parameters like visibility of gingiva, appearance of teeth and other facial structure affects smile aesthetics.¹ It is important to consider these factors as it can change treatment planning. For attractive smile analyses of smile arc and smile type is important. This can affect psychosocial well-being.² When the maxillary incisor follows same curvature of lower lip it is called parallel smile arc. When this relation is straight or reverse it is classified as straight and reverse smile arc. The position of the upper lip and gingival display during smiling is described as smile type. Tjan et al. classified

smiles according to the amount of maxillary tooth and gingival display and described the average smile as one in which the full length of the maxillary anterior teeth is visible with minimal gingival display. 1–2 mm of gingiva visible while smiling is called high smile with complete display of the maxillary central incisors. Average smile means when there is visibility of interdental papilla and entire maxillary incisor length. Low smile type is related with zero visibility of gingiva while smiling. Smile arc is categorized as parallel, straight or reverse.³ Smile aesthetics can be improved by maintaining parallel smile arc while treatment planning.⁴ Al taki et

al in there study evaluated that change in smile arc, buccal corridor width, gingival display affects the attractiveness of smile among people⁵. Smile characteristics were evaluated by using digital tools in many studies. Use of photographic and digital method to evaluate these parameters in various Indian studies and other study carried by Sarver DM et al have also reported, so the use of this method in this present study is relevant^{6,7}. This study is based on evaluation of smile type and the relationship between the maxillary incisal curvature and lower lip in young dentate participants from Kheda District, Gujarat. Conducted at Dharmsinh Desai University, Faculty of Dental Science.

The null hypothesis is there was no statistical association between smile type and maxillary incisal curvature–lower lip relationship.

Ethical Considerations

The study was conducted in according to institutional ethical requirements, and Institutional Review Board approval was obtained. Consent from each participants were collected.

MATERIAL AND METHODS

Study Design and Participants

This study included 100 young dentate participants from the Kheda–Nadiad region of Gujarat, India. Simple random sampling technique was used. Age group between 18 and 24 years with complete dentition, no missing teeth and with no history of orthodontic or prosthodontic treatment, and willingness to participate were included. Presence of facial asymmetry, craniofacial anomalies, surgical procedures affecting the lips or anterior teeth are exclusion criteria.

Sample Size -100 participants were evaluated. The sample-size was obtained using G*Power software version 3.1.9.4.

Photographic Procedure

Smile photographs were taken with Canon EOS R100 digital camera (Canon Inc., Japan). A custom-fabricated stand with chin support was used for standard head position. 4 feet distance between camera and participants was used with standardized camera setting for all participants.



Figure 1: Chin supported custom fabricated stand

Digital Image Analysis

Photographs were transferred to Adobe Photoshop version 27.2.0 for analysis. The smile line and the lower lip/incisal relationship

were assessed digitally using reference lines drawn in different colors. The relationship between the maxillary incisal curvature and lower lip was categorized as parallel, straight or reverse³.



Figure 2: Parallel maxillary incisal curvature to lower lip relationship (Smile arc)

Figure 3: Smile arc

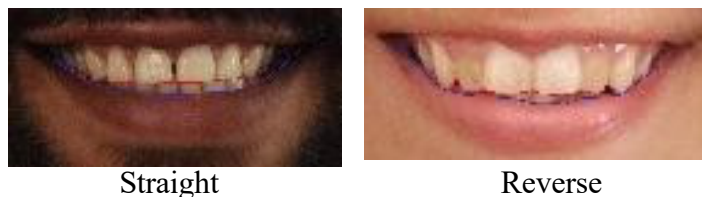


Figure 4: Smile type



Statistical Analysis

Data were analysed using IBM SPSS Statistics for Windows, version 20.0. Categorical variables were summarised using frequencies and percentages. The association between smile type and maxillary incisal curvature-lower lip relationship was evaluated using the Pearson chi-square test. Statistical significance was set at $P < 0.05$.

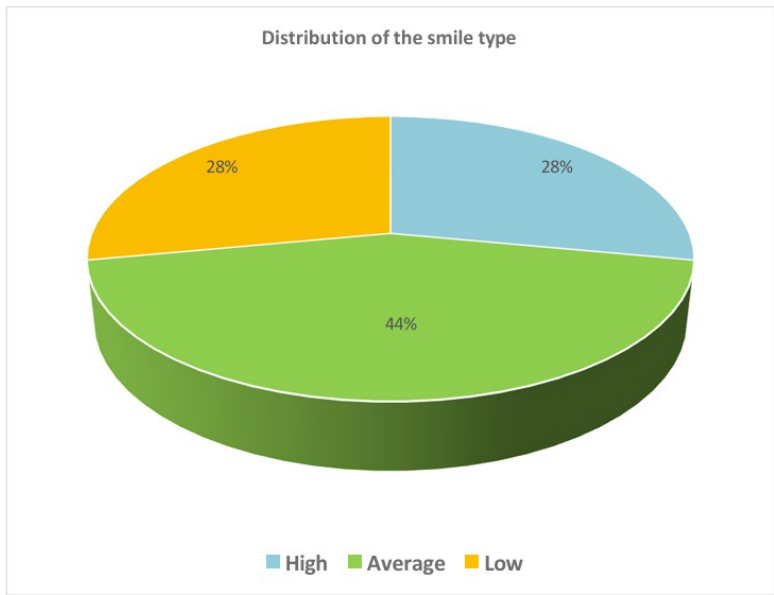
RESULTS

Distribution of Smile Type

All 100 participants were included in the analysis. The prevalence of average smile type was highest, occurring in 44 participants (44%). High and low smile types were each observed in 28 participants (28%).

Table 1. Distribution of smile type among the study participants.

Smile type	n	%
High	28	28
Average	44	44
Low	28	28
Total	100	100



Graph 1: Distribution of the smile type

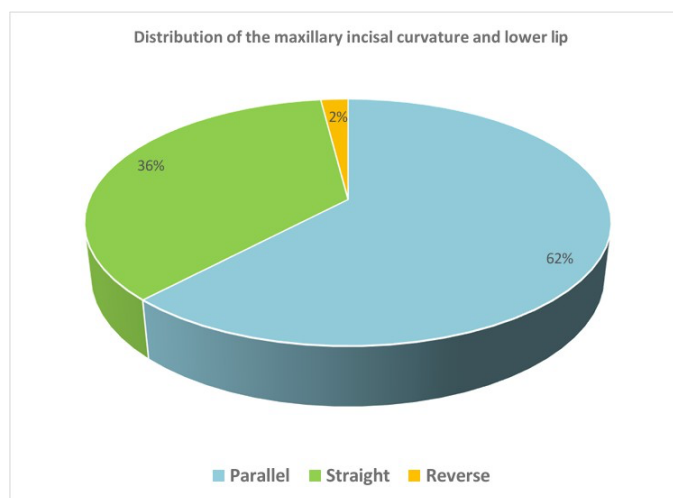
Distribution of Maxillary Incisal Curvature–Lower Lip Relationship

A parallel relationship between the maxillary incisal curvature and lower lip was observed in 62 participants (62%). A straight relationship was present in 36 participants (36%), whereas a reverse relationship was observed in 2 participants (2%). Thus, the parallel or consonant smile arc was the predominant configuration.

This pie chart represents the distribution of smile types in the study population. The green segment, which forms the largest portion of the chart, corresponds to the average smile type, accounting for 44% of participants. The blue segment represents the high smile type, comprising 28% of the sample, while the yellow segment represents the low smile type, accounting for 28% as well.

Table 2. Distribution of maxillary incisal curvature–lower lip relationship.

Maxillary incisal curvature–lower lip relationship	n	%
Parallel	62	62
Straight	36	36
Reverse	2	2
Total	100	100



Graph 2: Distribution of the maxillary incisal curvature and lower lip

This pie chart illustrates the distribution of the relationship between the maxillary incisal curvature and the lower lip in the study population. The blue segment, which constitutes the largest portion of the chart, represents the parallel relationship, accounting for 62% of participants. The green segment corresponds to the straight relationship, observed in 36% of the sample. The yellow segment, the smallest, represents the reverse relationship, observed in only 2% of participants. The chart clearly demonstrates that a parallel relationship between the maxillary incisal curvature and the lower

lip is the most prevalent, while the reverse relationship is rarely observed.

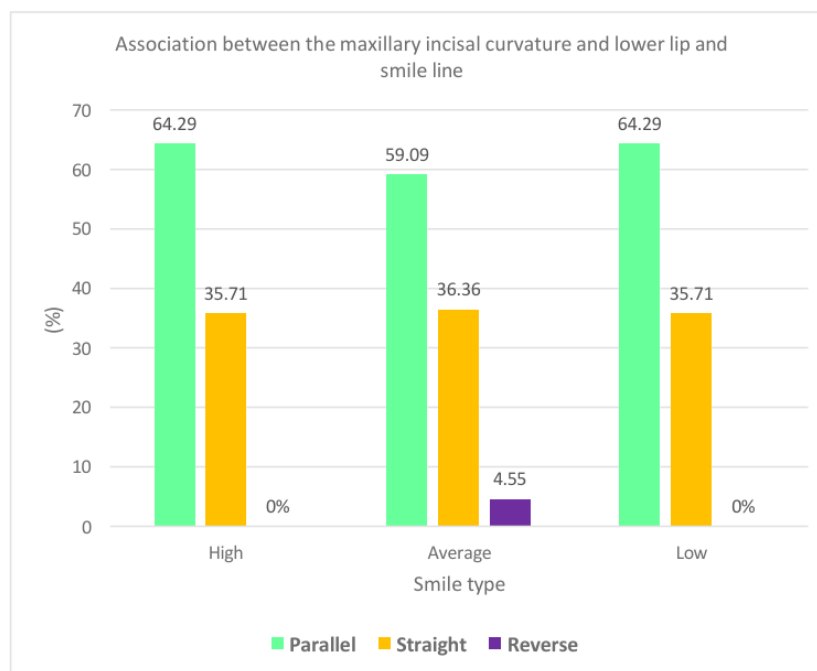
Association Between Smile Type and Smile Arc

Among participants with a high smile, 18 (64.29%) had a parallel arc and 10 (35.71%) had a straight arc; no reverse arcs were observed. Among participants with an average smile, 26 (59.09%) had a parallel arc, 16 (36.36%) had a straight arc and 2 (4.55%) had a reverse arc. Among participants with a low smile, 18 (64.29%) had a parallel arc and 10 (35.71%) had a straight arc; no reverse arcs were observed.

Table 3. Association between smile type and maxillary incisal curvature–lower lip relationship.

Smile type	Parallel, n (%)	Straight, n (%)	Reverse, n (%)	Total, n (%)
High	18 (64.29)	10 (35.71)	0 (0)	28 (100)
Average	26 (59.09)	16 (36.36)	2 (4.55)	44 (100)
Low	18 (64.29)	10 (35.71)	0 (0)	28 (100)
Total	62 (62)	36 (36)	2 (2)	100

Pearson chi-square analysis showed no statistically significant association between smile type and maxillary incisal curvature–lower lip relationship ($\chi^2=2.65$, $P=0.63$).



Graph 3: Association between the maxillary incisal curvature and lower lip and smile type This graph depicts the association between the maxillary incisal curvature and the lower lip across different smile types. The finding states that smile arc is a separate parameter and should be considered separately.

DISCUSSION

This study evaluated the smile type and smile arc in individuals from the Kheda-Nadiad region of Gujarat. Photographic method was used as smile can properly analyzed using this method compared to direct intraoral examination. Smile arc and smile type can be evaluated properly if photographs are taken with stable head position. Vy Thi Nhat Nguyen et al used this method in their study. It is acceptable to use this method in present study. Adobe Photoshop 27.2.0 improves precision and outcome of result. Features of software like magnification and use of different color to draw reference line helps to evaluate smile arc. Smile type which is common in this study is average. In the study by Tjahjahl et al they stated that average smile type is aesthetically important factor. Broader age group was included in their study, younger age groups included in present study. So the balanced distribution of high and low smile types is seen. Parallel smile arc was the most common finding in this study, followed by straight and reverse smile arcs. This is similar with the principles given by Frush and Fisher. Ackerman stated that a parallel smile arc improves smile attractiveness. An important finding in the study was very low amount of reverse smile arcs. This is different from the studies that included older age groups so they show high amount of reverse smile arcs. Sarver¹⁰ said that ageing can cause incisal wear and is the reason for straight and reverse smile arc. In this present study participants were included from 18-25 years so presence of incisal wear is minimal so the high amount of parallel smile arcs and less amount of reverse smile arcs was observed. This finding was seen in study conducted by Soares et al¹¹ where same age group was used. Present study also states no association between smile type and smile arc this confirms that these aesthetic parameters function independently. It is important to understand the distribution of these factors for proper diagnosis and treatment planning. This study evaluated the population of Kheda-Nadiad, giving regional data, which is important for aesthetic treatment planning within this demographic area. This type of population-specific data are limited, that states clinical importance of study. Limitation of present study is that it was conducted on a specific geographic region, which can be different from other regional areas.

Smile photos that were taken were static and not dynamic can cause bias. Studies with broader age group can be conducted. Parameters like number of teeth visible while smiling, midline of teeth, facial midline, shade of teeth can affect the aesthetic outcomes which can be included in study. Studies with dynamic photograph can be done.

CONCLUSION

It can be concluded that the average smile type was the most common, followed by high and low smile types and parallel relationship between the maxillary incisal curvature and the lower lip was the most commonly observed while reverse smile arcs were least seen.

REFERENCES

1. Dion K, Berscheid E, Walster E. What is beautiful is good. *J Pers Soc Psychol.* 1972;24:285–290.
2. Lukez A, Pavlic A, Trinajstić Zrinski M, Spalj S. The unique contribution of elements of smile aesthetics to psychosocial well-being. *J Oral Rehabil.* 2015;42:275–281.
3. Tjahjahl, Miller GD, The JGP. Some esthetic factors in a smile. *J Prosthet Dent.* 1984;51:24–28.
4. Ackerman JL, Ackerman MB, Brensinger CM, Landis JR. A morphometric analysis of the posed smile. *Clin Orthod Res.* 1998;1:2–11.
5. Al-Taki A, Khalesi M, Shadid R, et al. Perceptions of altered smile esthetics. *World J Orthod.* 2016;17(2):e45–53.

6. Proffit WR, Fields HW, Sarver DM. Contemporary Orthodontics. 6th ed. Philadelphia: Elsevier; 2018. p.156–175.
7. Gaikwad S, Kaur H, Vaz AC, Singh B, Taneja L, Vinod KS. Influence of smile arc on facial attractiveness: a cross-sectional study. J Clin Diagn Res. 2016;10:20–23.
8. Nguyen VTN, Tran NNT, Nguyen NH, Nguyen TDT. Evaluating smile aesthetic satisfaction and related smile characteristics in dental students. J Oral Biol Craniofac Res. 2024;14(1):92-97. doi:10.1016/j.jobcr.2024.01.002.
9. Frush JP, Fisher RD. The dynesthetic interpretation of the dentogenic concept. J Prosthet Dent. 1958;8(4):558–581.
10. Sarver DM. The importance of incisor positioning in the esthetic smile: the smile arc. Am J Orthod Dentofacial Orthop. 2001;120(2):98-111.
11. Soares GP, Valentino TA, Lima DANL, Paulillo LAMS, Silva FAP, Lovadino JR. Esthetic analysis of the smile. Braz J Oral Sci. 2007;6(21):1313-1319. doi:10.20396/bjos.v6i21.8642971.

FIGURE LEGENDS

Figure 1: Custom fabricated stand

Figure 2: Parallel maxillary incisal curvature to lower lip relationship (Smile arc)

Figure 3: Smile arc

Figure 4: Smile type