

ANALYSIS OF ANTERIOR DENTAL ESTHETIC PARAMETERS IN YOUNG INDIAN ADULTS: A CROSS-SECTIONAL STUDY

Dentistry

Dr. Renu Kundu* MDS, PhD Scholar, Gujarat University, Ahmedabad. *Corresponding Author

Dr. Dipti S Shah MDS, HOD & Dean, Department of Prosthodontics and Crown & Bridge, Karnavati School of Dentistry, Gandhinagar (Gujarat).

Naman Kadyan MBBS student, Maulana Azad Medical College, New Delhi.

ABSTRACT

Background & Objectives: Lip form and its relation with maxillary incisor visibility are not known in Indian adults. This study was designed to analyse types of lip form and their relation with maxillary incisor display at rest in young Indian adults.

Study design: Cross-sectional study

Material and Methods: Indian adults below 30 years of age were randomly selected from the OPD of Department of Prosthodontics. Digital facial photographs were taken and images were analysed with digital image analysis software.

Results: Out of the subjects chosen for this study, straight lip form was the most and high lip form was the least prevalent with an average display of maxillary incisor of 2.5 mm in male and 3.6 mm in female participants. A strong positive correlation exists between lip form and maxillary incisor display. Lip form plays a significant role in designing dental esthetic restorations in young adults.

KEYWORDS

Anterior esthetic parameters, Lip form, Esthetic restoration, Repose

INTRODUCTION:

One of the most important aspects of dental and facial esthetics is vertical anterior tooth display. Esthetic judgments are made by viewing a patient in dynamic states like smiling, talking or other facial expressions from front^[1,2]. Historically, dental esthetic evaluation has included maxillary incisor length, incisor display with lips in repose^[3], incisal edge position, tooth proportions, tooth and gingival display on smiling, midline position and amount of buccal corridor display^[4-10]. Methods of gathering these values are often surveys or direct measurements.

Tjan and Miller^[5] in a study of the full smiles of 454 students, aged 20–30 years, divided the smile line into three types: a high smile line, revealing the complete maxillary incisors and a continuous band of the gingiva; an average smile, revealing 75–100% of the maxillary incisors; and a low smile, revealing less than 75% of the maxillary incisors. Cutbirth^[11] in 2014; suggested a preliminary classification of different lip phenotypes but without defining specific parameters. He presented 3 lip phenotypes; straight, moderately arched, and maximally arched but did not define where one form leads to the next or how to obtain specific measurements.

Lips in repose have long been considered an esthetic parameter^[12-14]. Evaluation of lips at rest or repose may differ from clinician to clinician, as it is dependent on varying amounts of muscle flexure and parting of the lips, as well as the technique used to get the patient in that position. Also, the other variable that has yet to be explored is whether lip form influences the esthetic evaluation of incisal display. Kim et al^[3] has given a classification of Lip form based on the distance from the highest portion of lower vermilion border of upper lip from a line passing through the commissures of the mouth as Straight lip form (0-3 mm), Moderate (3-6 mm) and high lip form (more than 6). This study was done in American white population.

The current literature available on the esthetics of the face and smile is very vast and always been discussed among dental professionals as well as has become interesting to people of different cultures, social classes and ages^[6,7]. As Lip form and correlation between lip form and incisal display has not been studied in Indian population. This study was planned to study the correlation between Lip form and Incisal display and to find the most common form of Lip form in young Indian population.

MATERIALS:

DSLR digital camera with Tripod

A Canon EOS 70 D DSLR camera with the following specifications was used for the study. A minimum of 10 Mega Pixels is recommended for digital dental photography^[15]. The camera used in this study was

with image resolution of 20.2 MP and APS-C 'Dual pixel CMOS AF' sensor and DIGIC 5+ image processor. It had a silent shutter mode with fully articulated touch screen, 1040k dot 3" ClearView II LCD, with 3:2 aspect ratio. Specifications of the lens of the camera were Canon EF-S 18-135 mm f/3.5-5.6 IS STM with fixed focal length of 18-135 mm which was according to specifications for digital dental photography^[15,16]. This lens has a generous and versatile optical zoom ratio of 7.5x with a 35mm equivalent range of about 29-216mm. It is optimized for quieter and smoother focusing during live view and movies with a new stepper motor ("STM") design.

Photographic Room

A proper photographic room was used with an adjustable chair and green background to provide contrast. A DSLR camera with tripod was placed at a distance of 5 feet for standardization of all the images. The lens of the camera was adjusted to patient's eye level and they were made to sit with natural head position.

Digital Image Analysis Software: Image J analyzer (Fiji app)

Fiji app of Image J1.53 C version of Image J digital image analysis software was used for taking measurements of Incisal display and Lip form. It is a Java (Java 1.8.0_172 (64-bit) based image processing program developed by Wayne Rasband, National Institutes of Health, USA. Image J software can display, process, analyze, edit & save and print 8-bit color and grayscale, 16-bit integer, and 32-bit floating point images. Also can read many image file formats e.g. TIFF, BMP, PNG, JPEG, GIF etc. This software supports standard image processing functions such as logical and arithmetical operations between images, sharpening, edge detection contrast manipulation; and also can measure distances & angles.

METHODS:

This study was conducted in Department of Prosthodontics and Crown & Bridge in Karnavati School of Dentistry Gandhinagar. The ethical clearance for the study was obtained from the Institutional Ethical Committee. A total of 200 subjects were selected for the study between age group of 18-30 years.

The inclusion and exclusion criteria used were as following:

INCLUSION CRITERIA:

- Subjects between age group of 18-30 years
- Subjects with all anterior teeth present
- Subjects with normal neuro-muscular control

EXCLUSION CRITERIA:

- Subjects with any anterior teeth missing
- Subjects who have undergone Orthodontic treatment
- Subjects with worn dentition
- Uncooperative individuals

Lip form and Incisal display measurements were made with the software from the facial photographs of the subjects obtained with the lips in repose and relaxed mandibular posture. The procedure followed was as: Subjects were made to sit in front of the camera in an erect posture with their heads in the esthetic position. The esthetic position or natural head position is defined "as the position of the head in a standing up or an erect sitting individual, with his/her visual axis oriented horizontally"^[17]. To achieve the patients' lips in repose, they were instructed to say "hi" with a relaxed upper lip without smiling and then keeping their lips gently parted^[18]. The posture of each and every subject was verified twice before taking photographs to ensure that the lips were at repose and the teeth slightly apart. While taking facial photographs, a metal scale was placed on the side of the face horizontally to calibrate the software scale with known distance to make correct relative measurements and to avoid any zooming errors.

After collecting the photographs of all the subjects, measurements were made with Image J software (Version 1.53 C; Fiji app) digitally for collecting the data. The procedure followed to make measurements was as: A straight line was drawn passing through the commissures of the lips horizontally as a reference line to measure lip form. Then a perpendicular line to this line was drawn from the highest part of lower vermilion border of upper lip (Fig. 1). Then the Lip form of the subjects was determined based on this vertical distance measured in accordance with the Lip Form classification given by Kim et al^[3] in 2017 as:

Straight (Type 1): 0-3 mm
Moderate (Type 2): >3-6 mm
High (Type 3): > 6 mm

The amounts of upper and lower central incisors displayed were then measured from the incisal edge of left maxillary central incisor to highest point of

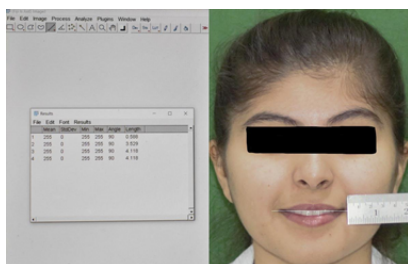


Figure-1. Digital Facial measurements taken with Image J software

lower vermilion border of upper lip and from the incisal edge of right mandibular central incisor to lowest point of upper vermilion border of lower lip respectively (Fig. 1). When an incisor could not be seen, the measurement was taken as zero. The measurements hence made were recorded for statistical analysis.

STATISTICAL ANALYSIS:

Statistical software SPSS 21 (IBM SPSS V 21) was used for statistical analysis. Data was uniformly distributed so parametric tests- Pearson Correlation, Scatter plot, Independent sample t-test were applied to find correlation between Incisal display and Lip form and other inter & intra group comparisons.

RESULTS:

Out of 200 subjects, 135 subjects had Straight Lip form, 62 had Moderate and only 3 subjects had High Lip form, hence, Straight Lip form being the most common among young Indian adults. The mean of incisal displays observed was $4.6 \text{ mm} \pm 1.9 \text{ SD}$ with more incisal display in female subjects with a mean of $4.9 \pm 1.8 \text{ SD}$ as compared to male subjects with a mean of $3.4 \pm 1.1 \text{ SD}$ respectively (Table 1).

Table 1. Showing descriptive analysis of various groups for Lip form and Incisal display

Characteristics Measured	Subjects	N	Mean	Std. Deviation	Std. Error Mean
Lip form (mm)	Male	45	2.572	1.29693	0.19334
	Female	155	2.461	1.53611	0.12338
	Total	200	2.486	1.48328	0.10488

Incisal display (mm)	Male	45	3.386	2.11410	0.31515
	Female	155	4.905	1.80576	0.14504
	Total	200	4.564	1.97895	0.13993
Straight Lip Form	Incisal display (Male)	32	3.107	2.08419	0.36844
	Incisal display (Female)	103	4.506	1.70098	0.16760
	Total	135	4.174	1.88782	0.16248
Moderate Lip Form	Incisal display (Male)	12	3.866	2.05989	0.59464
	Incisal display (Female)	50	5.676	1.72835	0.24447
	Total	62	5.326	1.91964	0.24379
High Lip Form	Incisal display (Male)	1	6.557	-	-
	Incisal display (Female)	2	6.23	3.31067	2.3410
	Total	3	6.3390	2.34860	1.35597

The Pearson Correlation coefficient to show the correlation between Lip form and Incisal display was observed as $r=0.000$, $p<0.01$ which was statistically significant. So, a positive correlation was found between Lip form and incisal display of all the subjects depicted by a scatterplot (Fig 2) which means when the Lip form changes from Straight to Moderate to High, the maxillary incisal display also increases.

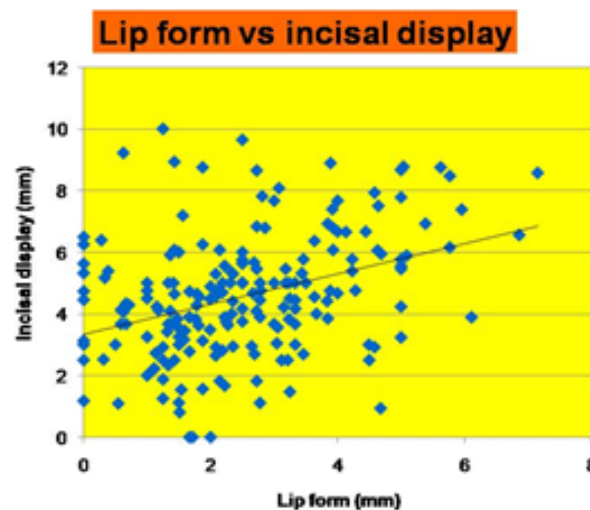


Figure 2. Scatterplot showing comparison between Lip Form and Incisal Display of all the subjects

Intra group comparisons between Male and Female groups also showed a positive correlation between Lip form and Incisal display as depicted by Scatterplot (Fig 3) with a Pearson Correlation coefficient $r=0.028$, $P<0.05$ for male subjects and $r=0.000$, $p<0.01$ for female subjects respectively.

Independent sample t-test was used for intergroup comparison between male and female groups, which showed no statistically

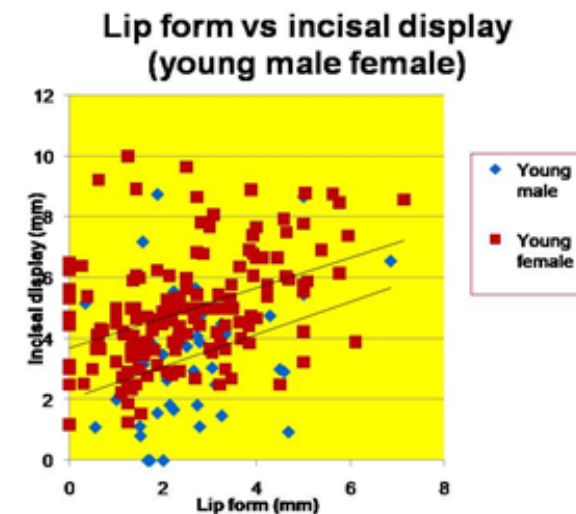


Figure 3. Scatterplot showing comparison between Lip Form and Incisal Display of Male and Female subjects

significant differences in lip form between male & female groups (t sign 2-tailed =0.660, $P>0.05$), but a highly significant difference was found in incisal display of male & female groups (t sign 2-tailed =0.000, $p<0.05$) (Table 2) which means that female subjects have more incisal displays as compared to male subjects for a particular type of Lip form.

DISCUSSION:

Maxillary incisal display is considered one of the most important attributes of the smile esthetics^[18]. Numerous studies have studied the effect of gingival & papilla display on esthetic preferences, gingival and tooth display on smile, incisal display with lips in repose but none of them have studied correlation between incisal display and Lip form. So, this was the first of its kind of study in which correlation between Lip form and incisal display and most common type of

Independent Sample t-Test		Lip form in mm		Incisal display in mm	
		Equal variances assumed	Equal variances not assumed	Equal variances assumed	Equal variances not assumed
Levene's Test for EOV	F	3.53		1.49	
	Sig	.062		.223	
t-test for Equality of Means	t	.441	.484	-4.78	-4.38
	df	198	83.2	198	63.8
	Sig. (2-tailed)	.660	.630	.000	.000
	Mean Difference	.111	.111	-1.52	-1.52
	Standard error difference	.25168	.22935	.31812	.34693
	95% Confidence Interval of the Difference	Lower	-3.8531	-3.4515	-2.14677
		Upper	.607	.567	-.892

*EOV- Equality of Variances

Table 2. Intergroup comparison between Lip form and Incisal display between male & Female groups using Independent sample t-Test

Lip form in Young Indian population was studied. According to the results of the above study, it was found that the most common type of Lip form in young Indian population is Straight (Type 1) Lip form according to classification given by Kim et al in 2017. Also, it was reported that young females have more maxillary incisal display as compared to males for a particular type of lip form (Table 1) which is in accordance with the study by Kim et al^[3]. A strong correlation was found between lip form and incisal display which means as lip form increases maxillary incisal display also increases.

From the era of dentogenic concept given by Frush and Fischer^[19] to modern era of digital smile design, it is very well established fact that age, sex and personality of the individual plays a vital role in smile design. Males and females present with a different levels of incisal display at rest or repose. So, a thorough understanding of esthetic incisal display at rest is very crucial during treatment planning. While designing the smile digitally using various digital softwares, lip form can be incorporated to determine the appropriate incisal edge position.

CONCLUSION:

Lip form can be considered as one of the most important esthetic parameters in Prosthodontic rehabilitation. A positive correlation exists between lip form and incisal display in young adults. So, by identifying proper lip form in patients, will be easier to provide more esthetically pleasing restorations especially in anterior esthetic corrections and full mouth rehabilitation cases.

Conflicts of Interest: Nil

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