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ESTHETIC PERCEPTION OF SMILE AMONG LAY PERSONS, GENERAL DENTISTS, ORTHODONTISTS AND ORTHODONTIC PATIENTS -A SURVEY STUDY

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Abstract:

Introduction: An attractive, well-balanced smile is a paramount treatment objective of modern orthodontic therapy. Extensive studies on facial features have resulted in the establishment of norms that orthodontists use as guidelines to evaluate facial forms and to direct therapy.

Aim: The current study implies the preferences of the lay persons, orthodontist, general dentist and orthodontic patients in different parameters of smile esthetics.

Methods:Acomputer-basedquestionnaire was used which comprised of demographic survy and multiple photographs of smiles.The study population was asked to select the most preferred smile from the digitally altered photographs of smile variables in frontal,lateral and three quarter views.

Result:Chisquare test was done to analyse, significant was set as $p<0.05$.

Conclusion:Dental knowledge background plays role in smile preference

Key Words: Smile Perception, Esthetics, Smile Variables, Digitally Altered Smile Photographs

Introduction:

In our culture, physical attractiveness is considered to be of great importance, with the face being a key aspect of it[1]. The attractiveness of a person's face is strongly linked to their smile. During social interaction, the mouth and eyes are the main focus of attention on the face. A smile is an important part of facial expression and appearance. Sabri et al[2] have identified eight components that make up a beautiful smile, including tooth position, size, shape, color, and the amount of

gum displayed, as well as the framing of the lips[3]. All of these components must work together in harmony and symmetry to create an aesthetically pleasing smile. However, what is considered aesthetically pleasing can vary from person to person, depending on their personal experiences and social environment. Miller et al[4]stated that an observant eye can easily detect asymmetry or anything that is out of balance and harmony with the environment. Therefore, professional opinions on facial aesthetics may not always align with the perceptions and expectations of patients or laypeople[5].

Patients often seek orthodontic treatment to improve the appearance of their smile. As a result, analyzing a patient's smile becomes an essential part of the orthodontic diagnosis and treatment planning process. However, since a patient's expectations can be influenced by subjective perceptions, it is important to understand what they expect from the treatment. Smile analysis involves evaluating various factors, such as smile arc, buccal corridor space, gingival display, tooth proportions, dental and facial midlines, and tooth color[6]. All of these variables play a crucial role in the aesthetics of a smile. Furthermore, several studies have highlighted gender differences in smile parameters that vary across different populations[7]. Therefore, to achieve successful treatment outcomes and meet the expectations of patients, it is important to understand the components of an aesthetically pleasing smile.

Diamond et al[8] discovered that a person's perception of beauty is highly influenced by their surroundings and other environmental factors. Additionally, there is a difference in opinion regarding the aesthetics of a smile between professionals and the general population. Studies have shown that dental professionals and the general population have different preferences for smile aesthetics. Mc Leod[9,10] also noted that cultural differences can also impact the perception of a smile. For example, Canadian laypersons are less accepting of deviations from the ideal smile and have a narrower range of acceptability compared to people in the USA[11]. Similarly, different populations, such as US Caucasians, US American Asian Indians, and Indians living in India, have different preferences for smile aesthetics[12]. Therefore, it is crucial to conduct regional studies to understand the perceptions of different populations regarding smile aesthetics. However, to date, there have been no studies on the aesthetic perception of a smile among the South Indian population. This study aims to evaluate the differences in smile preferences among Indian orthodontists, general dentists, orthodontic patients, and laypersons in terms of frontal, lateral, and three-quarter smile views.

Materials and Methodology:

In June 2023, a survey was conducted in the Department of Orthodontics,xxx to evaluate smile preferences among two groups: professionals (Orthodontists and General Dentists) and non-professionals (Orthodontic Patients and Laypersons). The survey was designed as a computer-based questionnaire using Google Forms and distributed through various social media platforms. Ethical approval was obtained from the Institutional Review Board (xyxy) at ABC College, and anonymity was maintained throughout the study. No personal identification information was collected.

The survey for this study consisted of two parts. The first part was a descriptive survey that asked for demographic information such as name, age, gender, and category. The second part was multiple choice questions based on images that assessed smile esthetics from frontal, lateral, and three-quarter views. The sample size required for this study was determined to be 1266 using the formula n=4pq/d2, which was used in previous studies. After obtaining IRB approval, close-up photographs of an Indian woman's smile were taken in frontal, lateral, and three-quarter views using a DSLR Nikon camera with a Ring flash. These photographs were then digitally modified using Adobe Photoshop 6.0 version 13 software to alter specific variables.

The variables assessed include Smile arc, Buccal corridor space, Gingival display, Maxillary midline to face, Most posterior teeth visible, and occlusal cant on frontal view. In the lateral and three-quarter views, the Nasolabial angle, Mentolabial sulcus, Upper lip thickness, and Maxillary teeth exposure were evaluated. There are 6 smile variables in the frontal view, 3 in the lateral view, and 1 in the three-quarter view. The definitions and range of values for these variables were outlined in Table 1, based on mean and standard deviation values from prior studies reflecting smile esthetic discrepancy. Other facial structures such as the nose, chin, and cheeks were omitted from the smile photographs to minimize distractions and potential bias, except for the nasolabial angle and mentolabial sulcus in the lateral view, required for constructing the angle. Ten sets of manipulated smile photographs were assessed, each comprising 2 or 3 images manipulated within the specified range of values.

To be eligible for the study, all participants had to be 18 years or older and willing to take part. Participants were shown sets of photographs with varying smile aesthetics and were asked to choose the one they found most pleasing. To ensure the questionnaire's reliability,

the research team administered it twice to 10 participants per group, with a seven-day gap between the two. Reliability was evaluated using a reliability coefficient, and intraclass correlation coefficients were used to assess agreement within the same rater.

Table 1: Variables, Range of Values and Definitions

Smile variables	Range of values	Definitions
Smile arc	Ideal, Straight, Reverse	The smile arc is the relationship between the curvature of the incisal edges of maxillary incisors and canines to the curvature of the lower lip in the posed smile.
Buccal corridor space	Zero and Excessive	The horizontal distance of the total dark space on the both sides of the mouth.
Maxillarytofacial midline	Central, Rightshift and Left shift	Maxillarydentalmidline(measuredbetweencentralincisors) Compared with the facial midline(the center of the philtrum and nasaltip).
Gingival display	2mm,5mm, -1mm	Heightofvisiblegingivabetweenthelowerborderofthe upper lip and gingival zenith of the maxillary centralincisors.
Most posterior teeth Visible	Second premolarand First molar	The most posterior teeth exposed on both sides while smiling.
Occlusal cant	Zero, +4 degree and -4 degree	Amount of rotation in the maxillary teeth from the horizontal plane through the middle of the maxillary central incisors
Nasolabial angle	Ideal, Acute andObtuse	The angle between columella of the nose and anterior surface of the upper lip.
Mentolabial sulcus	Ideal, Deep andShallow	The Distinct line separating the lower lip from the chin.
Upper lip thickness	4mm and 6mm	Theverticaldistancefromthemostsuperiorpointofthecuspid'sbowtothemostinferiorportionofthetubercleofthe upper lip.
Maxillary teeth Exposure	100% and 50%	Height of visible maxillary central incisor on smiling dividedby the actual height of maxillary central incisor.

Statistical Analysis:

The data analysis was performed by SPSS for Windows version 20. Pearson Chi-Square test is used to analyze the data. The data were reported descriptively with the use of tables.

Results:

Table 2: Descriptive Table based on the age of the study subjects

Age Groups	Frequency	Percent
18 - 25 years	542	42.7
25 - 35 years	641	50.5
35 - 45 years	72	5.7
above 45 years	15	1.2

Table 2 shows that the age group of 25 - 35 years participated more in the survey(50.5%)

Table 3 : Descriptive Table based on the Gender of the study subjects

Gender	Frequency	Percent
Male	616	48.5
Female	654	51.5

Table3 shows female participants (52%) were more compared to male participants (48%)

Table 4 : Descriptive Table based on the Categories of the study subjects

Categories	Frequency	Percent
Orthodontist	301	23.7
General dentists	312	24.6
Orthodontic patients	329	25.9
Others	328	25.8

Table 4 shows the orthodontic patients participated more in the study. (25.9 %)

Table 5 : Descriptive Table based on the various Smile Designs of the study subject

Smile variables		Frequency	Percent
Smile arc	Straight	234	18.4
	Ideal	1009	79.4
	Reverse	27	2.1
Buccal corridor space	Zero	992	78.1
	Excess	278	21.9
Maxillary midline	Central	942	74.2
	Left shift	99	7.8
	Right shift	229	18.0
Gingival display	2mm	980	77.2
	5mm	86	6.8
	-1mm	204	16.1
Most posterior teeth visible	Upto molar	870	68.5
	Upto premolar	400	31.5
Occlusal cant	0°	1115	87.8
	-4°	118	9.3
	+4°	37	2.9
Nasolabial angle	Ideal (90°)	980	77.2
	Acute (110°)	99	7.8
	Obtuse(70°)	191	15.0
Mentolabial sulcus	Ideal	889	70.0
	Deep	266	20.9
	Shallow	115	9.1
Upper lip thickness	6mm	711	56.0
	4mm	559	44.0
Maxillary teeth exposure	100%	1173	92.4
	50%	97	7.6

Table 5 shows the descriptive data based on the various smile parameters

Table 6: Distribution of Smile arc among study population based on their Profession

Smile Designs		Category								
		Orthodontists		**General dentists**		**Orthodontic patients**		**Others**		**p- value**
		n	**%**	**N**	**%**	**N**	**%**	**N**	**%**	
Smile arc	Straight	39	13.0%	20	6.4%	38	11.6%	137	41.8%	<0.001
	Ideal	262	87.0%	286	91.7%	289	87.8%	172	52.4%	
	Reverse	0	.0%	6	1.9%	2	.6%	19	5.8%	

Chisquare test done; p <0.05 - Significant

Table 6 shows the participants preferred ideal smile arc compared to the straight and reverse smile arc and is highest among the general dentists(91.7%) and orthodontist (87%) is statistically significant.

Table 7: Distribution of Buccal Corridor Space among study population based on Profession

Smile Designs		Category								
		Orthodontists		**General dentists**		**Orthodontic patients**		**Others**		**p- value**
		N	**%**	**n**	**%**	**N**	**%**	**n**	**%**	
Buccal corridor space	Zero	277	92.0%	269	86.2%	309	93.9%	137	41.8%	<0.001
	Excess	24	8%	43	13.8%	20	6.1%	191	58.2%	

Chisquare test done; p <0.05 - Significant

Table 7 shows the participants preferred zero buccal corridor space compared to the excess and is highest among the orthodontic patients (93.9%) and orthodontists (92%) is statistically significant.

Table 8: Distribution of Maxillary Midline among study population based on Profession

Smile Designs		Category								
		Orthodontists		**General dentists**		**Orthodontic patients**		**Others**		**p- value**
		N	**%**	**n**	**%**	**n**	**%**	**n**	**%**	
Maxillary midline	Central	289	96%	244	78.2%	309	93.9%	100	30.5%	<0.001
	Left shift	8	2.7%	27	8.7%	9	2.7%	55	16.8%	
	Right shift	4	1.3%	41	13.1%	11	3.3%	173	52.7%	

Chisquare test done; p <0.05 - Significant

Table 8 shows the participants preferred midline coinciding in the center compared to the right and left midline and is highest among the orthodontist (96%) and is statistically significant.

Table 9: Distribution of Gingival Display among study population based on Profession

Smile Designs		Category								
		Orthodontists		**General dentists**		**Orthodontic patients**		**Others**		**p- value**
		n	**%**	**N**	**%**	**n**	**%**	**n**	**%**	
Gingival display	2mm	289	96%	260	83.3%	303	92.1%	128	39%	<0.001
	5mm	3	1%	14	4.5%	6	1.8%	63	19.2%	
	-1mm	9	3%	38	12.2%	20	6.1%	137	41.8%	

Chisquare test done; p <0.05 - Significant

Table 9 shows the participants preferred 2mm gingival display and is highest among the orthodontist (96%) and is statistically significant.

Table 10: Distribution of Most Posterior teeth Visible among study population

Smile Designs		Category								
		Orthodontists		**General dentists**		**Orthodontic patients**		**Others**		**p- value**
		n	**%**	**N**	**%**	**N**	**%**	**n**	**%**	
Most posterior teeth visible	Upto molar	282	93.7%	122	39.1%	316	96%	150	45.7%	<0.001
	Upto Premolar	19	6.3%	190	60.9%	13	4%	178	54.3%	

Chisquare test done; p <0.05 - Significant

Table 10 shows the participants preferred the visibility of teeth till molar and is highest among the orthodontic patients (96%) and is statistically significant.

Table 11: Distribution of Occlusal Cant among study population based on theirProfession

Smile Designs		Category								
		Orthodontist		**General dentists**		**Orthodontic patients**		**Others**		**p- value**
		n	**%**	**N**	**%**	**n**	**%**	**n**	**%**	
Occlusal cant	0°	294	97.7%	267	85.6%	316	96%	238	72.6%	<0.001
	-4°	2	0.7%	32	10.3%	8	2.4%	76	23.2%	
	+4°	5	1.7%	13	4.2%	5	1.5%	14	4.3%	

Chisquare test done; p <0.05 - Significant

Table 11 shows the participants preferred 0 degree occlusal cant and is highest among the orthodontist (97.7%) and is statistically significant.

Table 12: Distribution of Nasio-labial angle among study population based on Profession

Smile Designs		Category								
		Orthodontists		**General dentists**		**Orthodontic Patients**		**Others**		**p- value**
		N	**%**	**n**	**%**	**n**	**%**	**n**	**%**	
Nasolabial angle	Ideal (90°)	282	93.7%	263	84.3%	298	90.6%	137	41.8%	<0.001
	Acute (110°)	5	1.7%	19	6.1%	6	1.8%	69	21%	
	Obtuse (70°)	14	4.7%	30	9.6%	25	7.6%	122	37.2%	

Chisquare test done; p <0.05 – Significant

Table 12 shows the participants preferred ideal nasolabial angle and is highest among the orthodontist (93.7%) and is statistically significant.

Table 13: Distribution of Mentolabial Sulcus among study population based on Profession

Smile Designs		Category								
		Orthodontists		**General dentists**		**Orthodontic patients**		**Others**		**p- value**
		N	**%**	**N**	**%**	**n**	**%**	**n**	**%**	
Mento labial sulcus	Ideal	272	90.4%	233	74.7%	287	87.2%	97	29.6%	<0.001
	Deep	22	7.3%	43	13.8%	26	7.9%	175	53.4%	
	Shallow	7	2.3%	36	11.5%	16	4.9%	56	17.1%	

Chisquare test done ; p <0.05 - Significant

Table 13 shows the participants preferred ideal mentolabial sulcus and is highest among the orthodontist (90.4%) and is statistically significant.

Table 14 : Distribution of Upper lip thickness among study population based on Profession

Smile Designs		Category								
		Orthodontists		**General dentists**		**Orthodontic patients**		**Others**		**p- value**
		N	**%**	**n**	**%**	**N**	**%**	**n**	**%**	
Upper lip thickness	6mm	251	83.4%	242	77.6%	101	30.7%	117	35.7%	<0.001
	4mm	50	8.9%	70	12.5%	228	40.8%	211	37.7%	

Chisquare test done ; p <0.05 - Significant

Table 14 shows the participants preferred 6mm of upper lip thickness and is highest among the orthodontist (83.4%) and is statistically significant.

Table 15: Distribution of Maxillary Teeth exposure among study population

Smile Designs		Category								
		Orthodontists		**General dentists**		**Orthodontic patients**		**Others**		**p- value**
		N	**%**	**n**	**%**	**n**	**%**	**n**	**%**	
Maxillary teeth exposure	100%	289	96%	297	95.2%	325	98.8%	262	79.9%	<0.001
	50%	12	4%	15	4.8%	4	1.2%	66	20.1%	

Chisquare test done; p <0.05 - Significant

Table 15 shows the participants preferred 100 % of maxillary tooth exposure and is highest among the orthodontic patients (98.8%) and is statistically significant.

Discussion:

Esthetics is a branch of philosophy that deals with the study of beauty. It is one of several basic philosophical branches, including ethics, logic, politics, and metaphysics. Psychological research suggests that people who are considered attractive are treated differently than those who are not. The perception of beauty is subjective and influenced by various factors, such as culture, social status, and education. In modern society, a pleasant smile is crucial for social interactions, job interviews, and other situations. In orthodontic treatment, esthetics has traditionally been associated with improving one's profile. Among all human expressions, a smile is perhaps the most pleasant and desired one.

In orthodontics, achieving a "balanced" smile is the most important esthetic goal. Orthodontists strive to create a harmonious balance that will result in the most attractive smile for each patient. According to Hulsey, a consonance between the arcs formed by the maxillary anterior teeth incisal edges and the curvature of the lower lip is a crucial component of an esthetic smile. Various factors contribute to a balanced smile, including lip line, buccal corridor, smile arc, upper-lip curvature, smile symmetry, frontal occlusal plane, dental components, and gingival components. In a recent study, orthodontic patients, general dentists, orthodontists, and laypersons had similar perceptions of smiles, which supports a previous study by Flores-Mir et al[13]. It was also found that the level of dental education has little impact on esthetic perception.

The current study found that orthodontists preferred 2mm of gingival exposure, while patients, dentists, and laypersons had differing perceptions of what makes a smile attractive. Previous research by Rodrigues et al[14]. showed that laypeople's assessments of smiles differed from objective esthetic norms. Meanwhile, according to Van der Geld et al[15]., smiles that expose clinical crowns and no more than 1mm of gingiva are considered more esthetic. In the present study, orthodontists found excessive gingival display to be the least attractive feature. In Malkinson et al[16].'s study, clinicians assessed smile esthetics and found that excess gingival display negatively impacted smile attractiveness and influenced how patients are perceived in terms of attractiveness, reliability, intelligence, and self-confidence.

A smile with an ideal arc is considered more attractive, while a flat arc is thought to be significantly less attractive. However, some studies have found that smile arc does not play a role in the esthetic value of a smile[17]. Ethnicity also influences preferences for smile arc type. For example, Caucasians tend to prefer an excessive smile arc, while Indians prefer an ideal arc. There are also notable differences between Caucasian and Korean populations in their preferences for smile arc type[18]. Nonetheless, in the present study, all orthodontists and general dentists chose the ideal smile arc as the most attractive.

In the present study, orthodontists preferred the midline of the teeth to coincide with the center, while midline diastema, spacing between teeth, crooked and asymmetric teeth with crowding were considered negative factors for smile appearance. According to Noureddine et al., the width of the midline diastema, even when associated with lateral spaces, significantly affects smile esthetics[19]. Generally, asymmetric alterations make teeth less attractive to both dental professionals and the lay public. Orthodontic patients in the study preferred 100% exposure of their maxillary teeth compared to the other groups. The shape of the anterior teeth, especially the maxillary teeth that are visible during smiling and speech, plays a significant role in fulfilling a patient's expectations from orthodontic treatment. Phillips found that the shape of the anterior teeth has a significant impact on smile esthetics, while Goldstein stated that tooth form and the smile arc are more critical elements than the golden ratio in tooth size. Ma et al[20]. observed that discrepancies related to central incisors had a much greater impact on smile esthetics than lateral incisors.

The current study found that orthodontic patients preferred 100% exposure of their maxillary teeth compared to the other groups. The shape of the anterior teeth, particularly the maxillary teeth, which are visible during smiling and speech, significantly contributes to fulfilling a patient's expectations from orthodontic treatment. Phillips noted that the shape of the anterior teeth has a significant impact on smile esthetics, while Goldstein stated that tooth form and the smile arc are more critical elements than the golden ratio in tooth size. Another study by Ma et al. found that discrepancies related to central incisors had a much greater impact on smile esthetics than lateral incisors.

In the current study, orthodontic patients preferred to have no space in their buccal corridors. However, orthodontists were more sensitive to buccal corridors than orthodontic patients and laypersons. Laypersons and orthodontists preferred smiles with minimal buccal corridors that parallel the lower lip's smile arc. The buccal corridor is the space that appears between the buccal surface of the posterior teeth and the corners of the lips when a person smiles. Orthodontists view buccal corridors as "negative" spaces. Moore et al. found that smile fullness can be classified into four categories: medium-narrow (28%), medium (15%), medium-broad (10%), and broad (2%) based on the percentage of buccal corridor.

Peck et al[21]. found that as individuals age, there is increased lip coverage of the maxillary incisors. Therefore, a high smile with 100% of the maxillary incisor exposure and a contiguous band of gingiva is characteristic of a younger population. In the present study, the majority of orthodontic patients preferred the visibility of their upper anterior teeth during a smile. The anterior teeth are crucial in determining the esthetics of a smile. Orthodontists, general dentists, and laypeople have different levels of sensitivity to specific dental esthetic discrepancies, which may help dental professionals make specific treatment recommendations. Laypeople tended to be less critical than orthodontists of all of the discrepancies. These varying levels of detectability indicate that minor variations in specific dental esthetic discrepancies may not be an important concern for most patients

Upper lip thickness and the nasolabial angle are features that can only be observed in the lateral view. In the current study, general dentists and orthodontists selected a 6-mm upper lip thickness as the most attractive in the lateral view. However, McNamara et al[22]. reported a 7mm upper lip thickness for white people of North American descent.

Loi et al[23]. found that both Japanese orthodontists and dental students preferred a profile with retruded lips and a nasolabial angle of 93.8^0 . Alcalde et al[24]. reported that the Japanese cephalometric norm for the nasolabial angle is 102.34^0 . In contrast, the participants in the present study preferred lips that were more ideal, with a 90^0 nasolabial angle.

Orthodontists prefer an ideal mentolabial sulcus. Nanda et al[25]. found that at 18 years of age, the average mentolabial angle was 125.1° in males and 127.1° in females. According to anthropometric studies by Farkas[26], the average values for adult North American Whites are 113.5° in males and 121.4° in females. However, discussions of the aesthetic analysis of the mentolabial region are relatively scarce in the literature compared to nasal aesthetic analysis. In the present study, orthodontic patients preferred to smile until their molars were visible in 96% of cases. Dong et al[27]. found that 57% of their sample displayed their maxillary second premolars, while Maulik and Nanda[28] reported that 51% of their sample showed maxillary second premolars and 25% showed first molars. Tjan et al. found that only 4% of their sample showed their maxillary first molars when smiling.

In the present study, orthodontists preferred an occlusal cant of 0^0 . However, Kokich et al[29]. found that laypersons did not detect this type of asymmetry unless it reached a 4º inclination. Padwa et al[30]. demonstrated that occlusal canting greater than 4º is detected clinically with a frequency of over 90% by both professionals and laypersons. Nonetheless, Ker et al[31]. observed that laypersons found occlusal canting of up to 4º acceptable, and a third of them found it acceptable up to a maximum of 6º. Previous studies did not have enough data on people's perception of all the factors associated with a smile. Therefore, this study aimed to provide a comprehensive understanding of the general public's perception.

Conclusion:

The group that conducted the most rigorous assessment of smiles included laypeople, orthodontists, general dentists, and orthodontic patients. However, there are significant differences between groups.

The majority of the smile parameters showed Orthodontists were more concerned regarding buccal corridor space, midline, gingival display, number of posterior teeth visible, nasolabial angle, and mentolabial sulcus. The orthodontist and the general

dentist have more knowledge of anatomy, treatment planning, and esthetics, hence the majority of esthetics preferencesevolved around them than the lay persons or orthodontic patients.

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