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Original Research Article

Role of canine vertical position and gingival zenith level on smile aesthetics and qualitative evaluation of perception by orthodontists, general dentists and laypersons: A descriptive cross-sectional study

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ABSTRACT

Introduction: Our objectives were to verify the impact of alterations in the vertical position of the maxillary canines in smile aesthetic perceptions and to determine whether exposure of the gingival margins directly affects laypersons' and orthodontists' perceptions.

Aim and Objective: To evaluate the impact of vertical position and gingival zenith level of maxillary canine on smile esthetics as judged by orthodontists, general dentist and laypersons

Materials and Methods: This is a qualitative, descriptive cross-sectional study aimed at studying the role of vertical position and gingival zenith level on the smile esthetic perception. A smiling photograph of a male subject with and without exposing the gingival zeniths was selected, and vertical positions and gingival zenith levels of canine were symmetrically modified in increments of 0.5 mm, creating two sets of 4 new modified images varying from 1.0 mm of intrusion to 1.0 mm of extrusion and 1.0 mm of increasing and decreasing the height with gingival exposure. The total of 15 images were evaluated by 40 orthodontists, 40 general dentists and 40 laypersons, who determined the level of attractiveness of each smile on a visual analog scale.

Results: Both smile arc (P <0.05) and gingival display amount (P <0.001) had statistically significant influences on the perception of smile attractiveness. Smile attractiveness scores with reference to gingival display amount showed a statistically significant (P <0.001) difference between the rater groups. A significant (P <0.05) interaction between smile arc and gingival display amount was observed. No significant difference were noted with standard smiles and intrusion smiles. Also, with 0.5mm extrusion and intrusion images in low smile. The intra-evaluator groups showed no significant difference between intrusion and extrusion high as well as low smile images, (P-value<0.05 for all). significant difference was seen in extrusion and intrusion high smile at 0.5mm and low smile images at 1mm level, extrusion and intrusion low smile images at 0.5mm level, (P-value>0.05 for all), significantly higher intrusion and extrusion high smile images at 0.5mm level, (P-value<0.05 for all). extrusion and intrusion high as well as low smile images at 1mm and 0.5mm levels, (P-value<0.05 for all).

Conclusions: Orthodontists were more critical in their assessments. There were no differences in the esthetic evaluations of smiles with and without gingival margin exposure for both groups of evaluators. For all the three evaluator groups, the most attractive ones were the standard smile and smile with the intrusion of 0.5 in high smile, standard and extrusion of 0.5 mm in the low smile group 0.5 mm of increased gingival zenith level (GZL) as perceived by orthodontists and general dentists, while for laypeople it was the standard smile. The unattractive smiles have extrusion and intrusion of 1mm for all the three evaluator groups 1 mm followed of decreased GZL of canine, for orthodontists and general dentist with 1mm increased. Laypeople, orthodontists scored all the images more critically by giving lesser scores compared to the general dentists and laypeople.

1. Introduction

Aristotle said, "Beauty is a greater recommendation than any letter of introduction". This statement is very apt in today's era where attractive people have a much better chance of being successful.[1,2]

Formerly, dental procedures were used to correct the consequences of malocclusion, caries, periodontal disease, and other dental problems. However, aesthetics has recently taken precedence over function, structure, and biology. Thus, nowadays, the most common reason for seeking orthodontic treatment is to improve the appearance of one's smile. As a result, orthodontists are attempting to combine aesthetics and function according to the needs and conditions of their patients.

Personal views and cultural standards play a vital role in perception of smile esthetics, as professionals and attentive lay individuals can identify an imbalance or lack of harmony in a smile.[3] Due to which, there may be difference of opinions between orthodontists, general dentists and laypersons.

Canines form the foundation of an esthetic smile as they are the cornerstone of the dentition. They contribute significantly to the functional occlusion and are the second most common impacted teeth. It is usually found that to improve the functional aspect and achieve harmonious contours, the vertical position of the maxillary canines is often changed; this certainly alters the relationship of the incisal edges and gingival margins of anterior teeth and may create unattractive steps.[4] Also, in a clinical situation with substitution of premolars as canines, the asymmetries are created in relation to the premolars gingival margins when compared with the canine on the other side.[5]

The symmetrical and asymmetrical gingival margin discrepancies along with vertical relationship of maxillary central and lateral incisors have been extensively studied in the past.

However, there is insufficient literature pertaining to the role of gingival margin and vertical position of the canine and its perception among laypersons and professionals. Correa et al has evaluated the effect of unilateral discrepancies of the gingival margin,[5] while Thais Teixeira de Paiva has studied the effect of altered vertical positions on the perception of the smile aesthetics.[6] The purpose of this study is to evaluate the differences in the perception of smile esthetics in symmetric alterations of maxillary canine by orthodontists, general dentists, and laypersons.

2. Materials and Methods

This study was approved by the university institutional review board and ethics committee. After screening various individuals, the respective participant was recruited for this study based on the inclusion and exclusion criteria mentioned below.

2.1. Inclusion criteria

2.1.1. For images

Participant: Age >18 years, well-aligned complete permanent dentition up to second molars with Class I molar and canine relationship, normal overjet and overbite <2 mm of gingival display and dental midline coinciding with facial midline.

2.1.2. For evaluators

1. Laypeople: With no training in dentistry or related courses
2. General dentist: Practicing any specialty other than orthodontics along with minimum 5 years of clinical experience.
3. Orthodontists: Having at least 5 years of clinical experience.

2.2. Exclusion criteria

2.2.1. For images

Participant: Previous orthodontic treatment**,** clinically evident skeletal asymmetry**,** facial trauma, agenesis and ectopy of anterior maxillary teeth**.** Any prosthesis or restorations in anterior maxillary segment**,** dental malocclusion**,** rotation of head**,** inadequate exposure of canines, any form of craniofacial syndrome or congenital defect and anterior or posterior cross bite

A written consent was taken from the participant authorizing the use of his images for this scientific study. A smiling photograph of the participant was selected, based on the fulfilment of the principles of an ideal smile previously documented by various authors.

This smile was also verified for its ideal properties using the templates available in the DSD software, as mentioned in the literature by Coachman et al.,(Figure 1A)[6,7]

The participant's maxillary central incisor was measured intraorally using a digital caliper for manipulation graduation, and these measurements were later utilized to calibrate the ruler in the software used for manipulations(Figure 1B).

2.3. Standardization of clicking the images

The frontal view photo was taken with a Digital Single-Lens Reflex Camera (DSLR) - Canon EOS 200D mounted to a frame set at a fixed distance of 36 inches between the lens and the subject(Figure 1C,D).

The photograph was taken while the participant was standing with the head in the Natural Head Position (NHP) as recorded by the fluid level device[8] with the eyes

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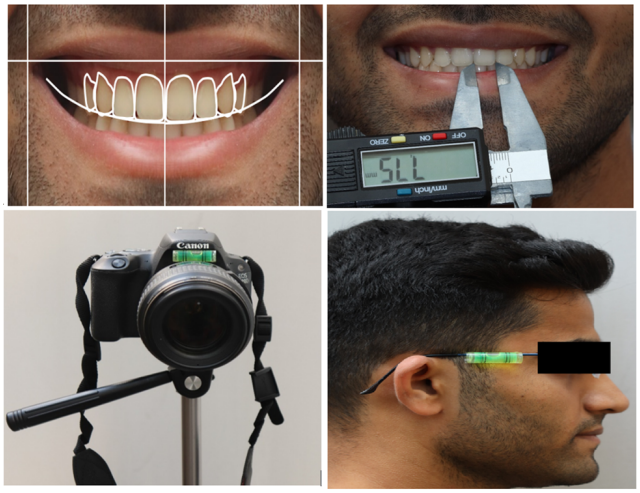

Figure 1: A): Superimposition of the DSD smile template over the smile of the participantselected for this study, **B)**: IntraoralMeasurement of Subject's Incisal Dimensions using Vernier Caliper, **C)**: DSLR mounted on a tripod with fluid leveldevice attached to it, **D)**: Image capture in NHP

fixed horizontally(Figure 1D). White background, free of shadows and distractions was used.

The smiling photograph was clicked, with exposure of gingival zeniths i.e., high smile. Before taking this image, the participant was instructed to smile and slightly open the mouth while smiling, to minimize the mandibular incisor display and promote contrast of the maxillary teeth with a darker background.

The social smile of the subject was captured because of its reproducibility in NHP(Figure 1D).(Figure 2E,Figure 3A).[9,10]

The image manipulations were done by Photo editing software by the same operator.

In the final image, one side was mirrored to ensure smile symmetry and then cropped to eliminate most of the nose, cheeks and chin to minimize the influence of background facial attractiveness. By eliminating most of the background and parameters not under orthodontic control, its influence on the perception of the evaluators was reduced. Thus, the image obtained was treated as a standard image.

2.4. Image manipulations

2.4.1. Manipulation of maxillary canine vertical position

This standard smile was manipulated by altering the maxillary canine vertical position symmetrically, by moving the canine in the cervical or occlusal direction in relation to the line tangent to the central incisors' edges. These variations did not alter the length or the proportion between width and height; thus, making them extrude and intrude by 0.5 and 1 mm respectively. Variations were made and mirrored to ensure perfectly symmetrical changes. This would consist of one set of 5 images(Figure 2 A, B,C,D,E).

In the next step, an upper lip manipulation was performed creating a low smile, to hide the gingival margins. This smile was used to make same vertical changes in the maxillary canines and obtain 5 new images with a low smile (standard smile, 2 intrusion smiles, and 2 extrusion smiles).

All the manipulations were performed by the same operator(Figure 3 A,B,C,D,E).

2.4.2. Manipulation of gingival zenith level of maxillary canines

Using gingival zenith level (GZL) of central incisors as a reference, the canines' GZL were matched with this line and GZL of lateral incisor was kept 0.5 mm below.

The gingival margins of the maxillary canines were altered bilaterally, increasing and decreasing the height, with discrepancies of 0.5 and 1mm. These alterations were done in relation to the most superior point, on the labial gingival margin of the central incisor and giving another set of 5 images.(Figure 4A,B,C,D,E)

2.4.2.1. Compilation and rating of images.

1. Finally, a set of 15 images were obtained for assessment by the evaluators (Figure 5). which were compiled into a google form document, in random order. An initial page consisting of all images grouped by the type of smile i.e., high and low smile images, were displayed in sequential order of vertical position of the canines and gingival zenith level in random order (Figure 6,Figure 7).
2. The evaluators were then asked to fill the google form and rate the images, without revealing the subject of the research to them.
3. Each image had an individual scale displayed below it, graded from 0 to 10, with 0 being the unattractive and 10 being most attractive smile, without identifying any characteristics of the image (Figure 6 ,Figure 7).
4. The evaluators were instructed to tap/mark on the scale at any point, corresponding to the desired score.

3. Result

The evaluators consisted of 40 orthodontists with at least 5 years of clinical experience, 40 general dentists with a clinical experience of 5 years or more and 40 laypeople who had no training in dentistry or related courses.

3.1. For manipulation of maxillary canine vertical position

3.1.1. Inter-group distribution of mean attractiveness score

(Table 1)

Figure 2: Set ofhigh smile images with manipulation of canine vertical position- **A)**: Standard Image, **B)**: 0.5 mm ofIntrusion, **C)**: 1 mm of Intrusion, **D)**: 0.5 mm of Extrusion, **E)**: 1mm of Extrusion

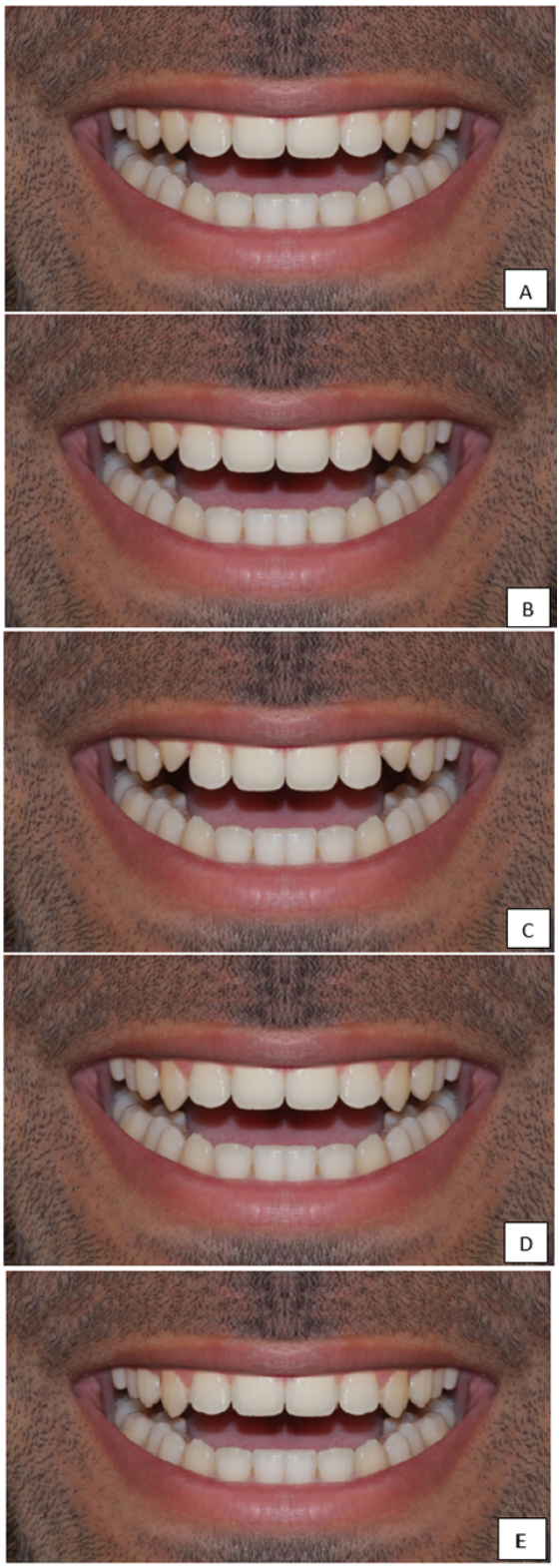

Figure 3: set of low smile images with manipulation of canine vertical position- **A)**: Standard Image, **B)**: 0.5 mm of Intrusion, **C)**: 1 mm of Intrusion, **D)**:0.5 mm of Extrusion, **E)**: 1 mm of Extrusion

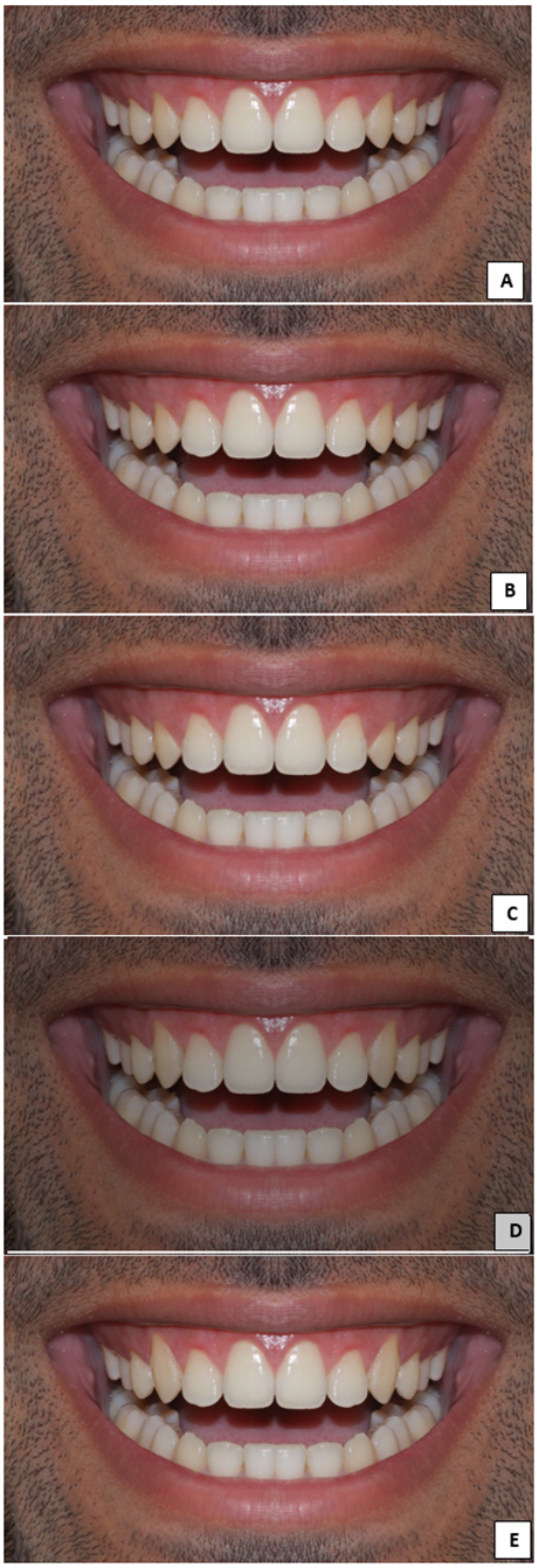

Figure 4: Set of images with manipulation of gingival zenith level -**A**): Standard Image, **B**):Decreased GZL by 0.5 mm, **C**): Decreased GZL by 1 mm, **D**):Increased GZL by 0.5 mm, **E**): Increased GZL by 0.5 mm

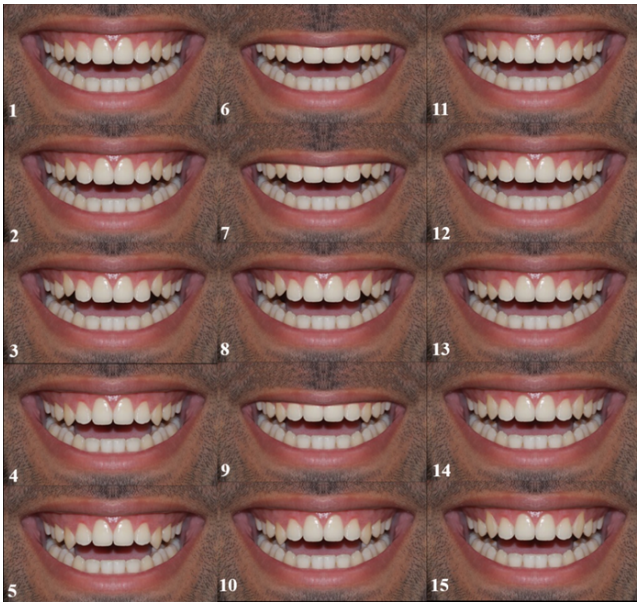

Figure 5: Final set of 15 images

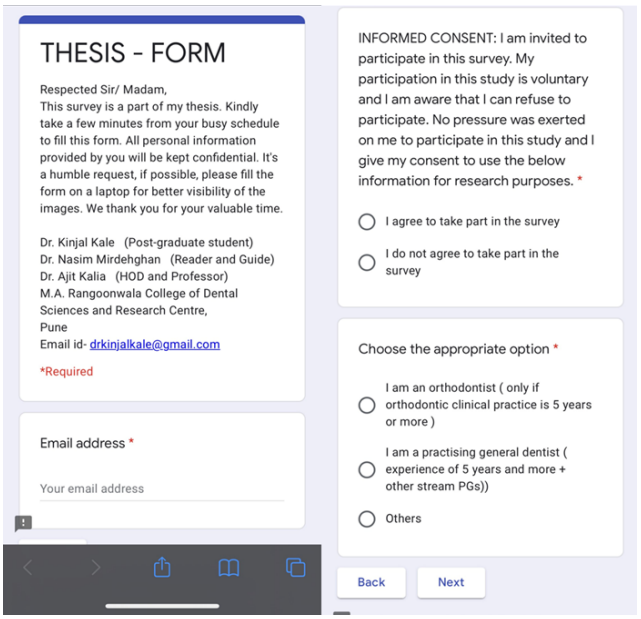

Figure 6: Google form

3.1.1.1. For the smiles with gingival display (high smile). All evaluators assigned the standard smiles the highest scores. (Orthodontists -7.40 ± 2.61, general dentists -7.22 ± 2.68, and laypeople -7.05 ± 2.50).

Orthodontists and general dentists assigned the lowest score to the 1mm extrusion image, with a mean score of 3.15 ± 2.65 and 3.4 ± 2.43, respectively, however laypeople assigned the lowest score to the 1mm intrusion smile, with a mean score of 4.65 ± 2.73.

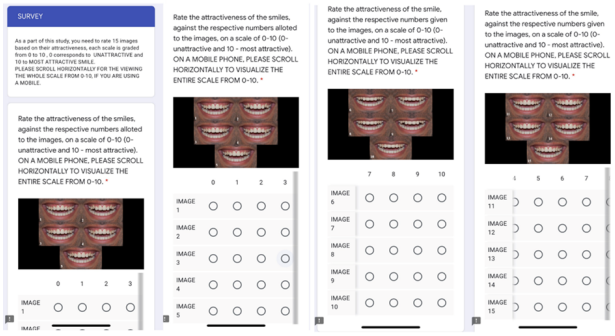

Figure 7: Google form displaying the sets of images along with the rating scale

3.1.1.2. For the smiles without gingival display (low smile). All evaluators gave the standard smiles the highest scores. (Mean score for orthodontists: 6.47 ± 2.74, general dentists: 7.07 ± 2.54, and laypeople: 6.15 ± 2.69).

Orthodontists and general dentists assigned the lowest score to the 1mm extrusion image, with a mean score of 2.47 ± 2.19 and 2.60 ± 2.24, respectively, but laypeople assigned the lowest score to the 1mm intrusion smile, with a mean score of 4.0 ± 2.74.

3.1.1.3. For all the images with altered vertical position of canines. All evaluators assigned standard photos the highest scores, whereas orthodontists and general dentists rated 1mm extrusion smiles the lowest, while laypeople rated 1mm intrusion smiles the highest.

3.1.2. Manipulation of gingival zenith level of maxillary canines

3.1.2.1. For images with altered gingival zenith level of canines. The highest scores were assigned to images with increase in GZL by 0.5 mm by orthodontists and general dentists with a mean score of 7.17± 2.33 and 6.92 ± 1.99, while laypeople assigned it to standard images with a mean score 6.67 ± 2.29(Table 4).

the lowest scores were assigned to images with 1mm decrease in GZL, by orthodontists and general dentists with a mean score of 4.75 ± 2.47 and 4.95 ± 2.36, while laypeople assigned it to 1mm increase in GZL with a mean score 5.47 ± 2.27.

3.2. Statistical comparison

3.2.1. Manipulation of maxillary canine vertical position

3.2.1.1. Inter-observer group statistical comparison of mean attractiveness score . Laypeople assigned significantly higher mean attractiveness scores compared to orthodontists and general dentists for extrusion high smile and low smile images at 1mm level (P-value<0.05 for all)(Table 2).

Laypeople assigned significantly higher mean attractiveness score compared to orthodontists for extrusion high smile images at 0.5mm level (P-value<0.05 for all).

Distribution of mean attractiveness score did not differ significantly for standard and intrusion high smile and low smile images at 1mm and 0.5mm level by all the observers (P-value>0.05 for all).

Distribution of mean attractiveness score did not differ significantly for extrusion and intrusion low smile images at 0.5mm level by all the observers (P-value>0.05 for all).

3.2.1.2. Intra-observer group statistical comparison of mean attractiveness score . Among extrusion and intrusion high smile and low smile images at 1mm level, mean attractiveness score did not differ significantly, as assigned by all the observers (P-value>0.05 for all)(Table 3).

Among extrusion and intrusion low smile images at 0.5mm level, mean attractiveness score did not differ significantly, as assigned by all the observers. (P-value>0.05 for all).

Among intrusion and extrusion high smile images at 0.5mm level, mean attractiveness score was found to be significantly higher for intrusion high smile images at 0.5mm level, as assigned by orthodontists and general dentists. (P-value<0.05 for all).

Among extrusion and intrusion high as well as low smile images at 1mm and 0.5mm levels, the mean attractiveness score was found to be significantly higher for standard image, as assigned by all the observers (P-value<0.05 for all).

3.2.2. Manipulation of gingival zenith level of maxillary canines

3.2.2.1. Inter-observer group statistical comparison . Laypeople allotted significantly higher scores compared to orthodontists for decreased gingival zenith level image at 1mm level (P-value<0.05)(Table 4,Table 5).

The mean scores did not differ significantly between orthodontics and general dentists as well as between general dentists and laypeople for decreased GZL image at 1mm level (P-value>0.05 for both).

Distribution of mean gingival zenith level did not differ significantly across three observer groups for decreased GZL by 0.5mm image as well as increased GZL by 1mm and 0.5mm images (P-value>0.05 for all).

3.2.2.2. Intra-observer group statistical comparison . Among the images with decreased GZL by 1mm and 0.5mm, the mean score did not significantly differ, as assigned by all the evaluators. (P-value>0.05 for all)(Table 6).

Among the images with increased GZL by 0.5mm and 1mm, significantly higher scores were allotted to the one with increased GZL by 0.5mm, by all the evaluators (P-value<0.05 for all).

Among images with decreased and increased GZL by 1mm, no significant difference was observed between the scores, as allotted by the evaluators (P-value>0.05 for all).

Among the images with increased and decreased GZL by 0.5mm, significantly higher scores were given to the ones with increased GZL by 0.5mm by orthodontists and general dentists (P-value>0.05 for all).

Among the standard image and increased as well as decreased GZL by 1mm and 0.5mm significantly higher scores were assigned to the standard images by all the evaluators (P-value<0.05 for all).

4. Discussion

Different esthetic characteristics were incorporated into treatment objectives due to the patients' growing desire for an appealing smile.[11–15]

The canines form the foundation of the dentition and are important for smile aesthetics. Due to the ambiguity in the size of the crown and differences between the right and left sides, the gingival margins are either gingival or occlusal to what is needed, making it difficult for clinicians to correct their malalignment.[14]

Dentists' experience, not patients' perspective, is frequently linked to their knowledge of an esthetically unpleasant smile. Minor gingival alterations of 1 to 2 mm are frequently only noticed by dentists, while patients barely do. Hence, the present study compared the perception among orthodontists, general dentists, and laypeople of smile esthetics.

The literature on people's perceptions of smile esthetics demonstrates a variety of approaches, with some preferring full-face views while taking other facial characteristics into account,[16,17] while others advising closeup views to eliminate distractions,[16,18] and few finding no appreciable differences between these two.[19,20]

Considering these facts, we focused on evaluating the effects of canine vertical positions and changes to the gingival zenith level on the aesthetics of smiles using lower-face close-up photographs.

Similar studies have been done in the past, where the standard smile was selected based on how well it complied with the ideal guidelines provided in the literature and/or how well it seemed to the observers. However, there was a chance of prejudice and inaccuracies because it completely relied on the perspective of a group of observers, community, or ethnicity. Therefore, in this study, the chosen smile and its proportions were validated using the templates offered by Coachman et al in the DSD software.[6,7]

The strategy for determining the optimal vertical position of the maxillary canines is somehow complex because when the positional alterations are made, not only the gingival architecture but also the canine edges are assessed.

Many studies have been done in the past to assess the ideal canine height-width ratio[21] as well as the threshold for the occurrence of gingival asymmetries of maxillary canines.[5,22]

These surveys, however, altered the height of the teeth rather than the vertical position, failing to recognize that modifying the gingival margins and canine edges would frequently alter the proportions of the teeth. Ideally, during the evaluation, it is important to isolate only one trait at a time, to evaluate the perception of an individual trait. The present study, therefore, adopted the same approach suggested in the literature, to change the vertical location of the maxillary canines, leaving the morphology of the teeth intact in the first part of the study.[11]

It is evident that with this approach, the amount of gingival display and the canine – central incisal edge relationship are decreased when maxillary canines are intruded, whereas when maxillary canines are extruded, the opposite is noticed. This study utilized the most researched approach, for evaluating the perception of smile esthetics, concerning the altered gingival margins of canine, thus altering the canine heights in the second part of the study.

This study data suggests that extreme modifications were rated more unpleasant in general, with extrusion modifications earning the lowest scores. For both groups-high and low smiles, the standard smiles were given the highest scores. Furthermore, the high smile group smiles with an intrusion of 0.5 mm were next in order of attractiveness, as per the study conducted by de Paiva TT et al,[4] who reported that the most attractive smile was the standard images. For the low smile group, extrusion of 0.5 mm was considered second most attractive, which was contrary to the results obtained by de Paiva TT et al.[4]

The contradictory results seen in this study compared to the above-mentioned study may be attributed to the discrepancy in the gingival margins of the central incisors and canines of the subject chosen. This is also previously reported in the literature that the highest scores were given to smiles exhibiting one significant feature, which is when the central incisor gingival margins synchronized or were 0.5 mm below the gingival margins of the canine. They also reported that the unattractive smiles had canine gingival margins 1.0 mm above or 1.5 mm below the central incisor gingival margins.[23]

Therefore, in this study, images with 0.5 mm of intrusion, gingival margins of central incisor and canine were synchronized, as a result, these images might have been perceived attractive by the three evaluator groups. Here, a tendency towards higher intolerance for extruded canines was observed in comparison to intruded ones.

The present study showed that the highest-rated smiles were with increased GZL by 0.5 mm followed by a standard smile, as per orthodontist and general dentist. For laypeople, the standard smile was the most attractive followed by decreased GZL by 0.5 mm. The lowest scores were attributed to decreased GZL by 1 mm, according

Table 1: Inter-group distribution of mean attractiveness score between three observers for each alignment and level.

			Group1: Orthodontics (n=40)		Group2: General dentist (n=40)		Group3: Others (n=40)	
Smile Type	**Alignment**	**Level**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
High	Extrusion	1mm	3.15	2.65	3.40	2.43	4.80	2.75
		0.5mm	4.22	2.30	4.95	2.34	5.72	2.54
	Intrusion	1mm	3.35	2.38	3.47	2.07	4.65	2.73
		0.5mm	5.90	2.75	6.40	1.97	6.27	2.74
	Standard		7.40	2.61	7.22	2.68	7.05	2.50
Low	Extrusion	1mm	2.47	2.19	2.60	2.24	4.15	2.44
		0.5mm	4.85	2.58	5.42	2.05	5.60	2.98
	Intrusion	1mm	2.92	2.79	2.92	2.12	4.00	2.74
		0.5mm	4.42	2.43	5.22	2.45	5.00	2.70
	Standard		6.47	2.74	7.07	2.54	6.15	2.69
Overall	Extrusion	1mm	2.81	2.44	3.00	2.35	4.47	2.60
		0.5mm	4.54	2.45	5.19	2.20	5.66	2.76
	Intrusion	1mm	3.14	2.58	3.20	2.10	4.32	2.74
		0.5mm	5.16	2.68	5.81	2.29	5.64	2.77
	Standard		6.94	2.70	7.15	2.60	6.60	2.62

Table 2: Inter-observer group statistical comparison of mean attractiveness score separately for each alignment and level.

Smile Type	**Alignment**	**Level**	**Group 1 (Orthodontics) vs Group 2 (General dentist)**	**Group 1 (Orthodontics) vs Group 3 (Others)**	**Group 2 (General dentist) vs Group 3(Others)**
High	Extrusion	1mm	0.999^{NS}	0.017^{*}	0.049^{*}
		0.5mm	0.537^{NS}	0.018^{*}	0.453^{NS}
	Intrusion	1mm	0.999^{NS}	0.052^{NS}	0.094^{NS}
		0.5mm	0.999^{NS}	0.999^{NS}	0.999^{NS}
	Standard		0.999^{NS}	0.999^{NS}	0.999^{NS}
Low	Extrusion	1mm	0.999^{NS}	0.004^{**}	0.009^{**}
		0.5mm	0.955^{NS}	0.581^{NS}	0.999^{NS}
	Intrusion	1mm	0.999^{NS}	0.191^{NS}	0.191^{NS}
		0.5mm	0.480^{NS}	0.934^{NS}	0.999^{NS}
	Standard		0.947^{NS}	0.999^{NS}	0.369^{NS}
Overall	Extrusion	1mm	0.999^{NS}	0.001^{***}	0.001^{***}
		0.5mm	0.296^{NS}	0.013^{*}	0.680^{NS}
	Intrusion	1mm	0.999^{NS}	0.009^{**}	0.014^{*}
		0.5mm	0.342^{NS}	0.743^{NS}	0.999^{NS}
	Standard		0.999^{NS}	0.999^{NS}	0.568^{NS}

P-value by ANOVA with Bonferroni's Post-Hoc test for multiple group comparisons: P-value<0.05 is considered to be statistically significant. *P-value<0.05, **P-value<0.01, ***P-value<0.001, NS – Statistically non-significant.

to orthodontists and general dentists, while images with increased GZL by 1 mm were scored lowest by laypeople. The next in order of unattractiveness were images with decreased GZL by 0.5 mm for orthodontist and by 1mm for laypeople, while increased GZL images by 1 mm for the general dentist.

The rationale for an orthodontist considering a smile with increased GZL by 0.5 mm as attractive, might be the discrepancy present in the standard smile originally as discussed before. Therefore, these results reveal that the orthodontists, in general, did not perceive alterations of maxillary gingival zenith levels up to 0.5 mm whereas general dentist and laypeople did not perceive alterations changes up to 1 mm.

Thus, the results of this study, are supportive to the findings of Correa et al, who evaluated the full-face and close-up smile views, to determine the perception of smile esthetics among orthodontists and laypeople concerning asymmetries in the maxillary canines' gingival margins.[5]

In this study, they observed that the orthodontists assigned the highest scores to the ones without asymmetries and the ones with a 0.5-mm asymmetry. The smiles without asymmetries and with asymmetries of 0.5, 1.0, and 1.5 mm were perceived most attractive by laypeople.[5]

Table 3: Intra-observer group statistical comparison of mean attractiveness score between two alignments at each level.

			Group 1 (Orthodontics) (n=40)		Group 2 (General dentist)(n=40)		Group 3 (Others) (n=40)	
Smile Type	**Alignment**	**Level**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
High	Extrusion	1mm	2.81	2.44	3.00	2.35	4.47	2.60
		0.5mm	4.54	2.45	5.19	2.20	5.66	2.76
	Intrusion	1mm	3.14	2.58	3.20	2.10	4.32	2.74
		0.5mm	5.16	2.68	5.81	2.29	5.64	2.77
	Standard		6.94	2.70	7.15	2.60	6.60	2.62
Low	Extrusion	1mm	2.81	2.44	3.00	2.35	4.47	2.60
		0.5mm	4.54	2.45	5.19	2.20	5.66	2.76
	Intrusion	1mm	3.14	2.58	3.20	2.10	4.32	2.74
		0.5mm	5.16	2.68	5.81	2.29	5.64	2.77
	Standard		6.94	2.70	7.15	2.60	6.60	2.62
Overall	Extrusion	1mm	2.81	2.44	3.00	2.35	4.47	2.60
		0.5mm	4.54	2.45	5.19	2.20	5.66	2.76
	Intrusion	1mm	3.14	2.58	3.20	2.10	4.32	2.74
		0.5mm	5.16	2.68	5.81	2.29	5.64	2.77
	Standard		6.94	2.70	7.15	2.60	6.60	2.62
		P Value						
High	Extrusion vs Intrusion	1mm	0.723^{NS}		0.882^{NS}		0.807^{NS}	
	Extrusion vs Intrusion	0.5mm	0.004^{**}		0.004^{**}		0.355^{NS}	
	Extrusion vs Standard		0.001^{***}		0.001^{***}		0.001^{***}	
	Intrusion vs Standard		0.001^{***}		0.001^{***}		0.001^{***}	
Low	Extrusion vs Intrusion	1mm	0.425^{NS}		0.507^{NS}		0.797^{NS}	
	Extrusion vs Intrusion	0.5mm	0.450^{NS}		0.693^{NS}		0.349^{NS}	
	Extrusion vs Standard		0.001^{***}		0.001^{***}		0.001^{***}	
	Intrusion vs Standard		0.001^{***}		0.001^{***}		0.001^{***}	
Overall	Extrusion vs Intrusion	1mm	0.415^{NS}		0.572^{NS}		0.723^{NS}	
	Extrusion vs Intrusion	0.5mm	0.126^{NS}		0.080^{NS}		0.954^{NS}	
	Extrusion vs Standard		0.001^{***}		0.001^{***}		0.001^{***}	
	Intrusion vs Standard		0.001^{***}		0.001^{***}		0.001^{***}	

P-value by ANOVA with Bonferroni's Post-Hoc test for multiple group comparisons: P-value<0.05 is considered to be statistically significant. **P-value<0.01, ***P-value<0.001, NS – Statistically non-significant.

Table 4: Inter-group distribution of mean gingival zenith level between three observers for each type and level

			Group 1 (Orthodontics) (n=40)		Group 2 (General dentist) (n=40)		Group 3 (Others) (n=40)	
Type	**Change**	**Level**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Overgrowth	Decrease	1mm	4.75	2.47	4.95	2.36	6.12	2.65
		0.5mm	5.40	2.31	5.67	2.45	6.45	2.62
Recession	Increase	1mm	5.55	2.47	5.12	2.43	5.47	2.27
		0.5mm	7.17	2.33	6.92	1.99	6.37	2.43
Standard			6.62	2.06	6.37	2.52	6.67	2.29

Table 5: Inter-observer group statistical comparison of mean gingival zenith level separately for each type and level

Type	Change	Level	Group 1 (Orthodontics) vs Group 2 (General dentist)	Group 1 (Orthodontics) vs Group 3 (Others)	Group 2 (General dentist) vs Group 3 (Others)
Overgrowth	Decrease	1mm	0.999^{NS}	0.046^{*}	0.113^{NS}
		0.5mm	0.999^{NS}	0.177^{NS}	0.487^{NS}
Recession	Increase	1mm	0.999^{NS}	0.999^{NS}	0.999^{NS}
		0.5mm	0.999^{NS}	0.349^{NS}	0.836^{NS}
Standard			0.999^{NS}	0.999^{NS}	0.999^{NS}

P-value by ANOVA with Bonferroni's Post-Hoc test for multiple group comparisons: P-value<0.05 is considered to be statistically significant. P-value<0.05, NS – Statistically non-significant.

Table 6: Intra-observer group statistical comparison of mean gingival zenith level between two types at each level

			Group 1 (Orthodontics) (n=40)		Group 2 (General dentist) (n=40)		Group 3 (Others) (n=40)	
Type	**Alignment**	**Level**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Overgrowth	Decrease	1mm	2.81	2.44	3.00	2.35	4.47	2.60
		0.5mm	4.54	2.45	5.19	2.20	5.66	2.76
Recession	Increase	1mm	3.14	2.58	3.20	2.10	4.32	2.74
		0.5mm	5.16	2.68	5.81	2.29	5.64	2.77
Standard			6.94	2.70	7.15	2.60	6.60	2.62
P value								
	Decrease	1mm vs 0.5mm	0.227^{NS}		0.182^{NS}		0.583^{NS}	
	Increase	1mm vs 0.5mm	0.003^{**}		0.001^{***}		0.048^{*}	
	Decrease vs Increase	1mm	0.151^{NS}		0.745^{NS}		0.243^{NS}	
	Decrease vs Increase	0.5mm	0.001^{***}		0.014^{*}		0.895^{NS}	
	Decrease vs Standard		0.001^{***}		0.001^{***}		0.001^{***}	
	Increase vs Standard		0.001^{***}		0.001^{***}		0.001^{***}	

P-value by ANOVA with Bonferroni's Post-Hoc test for multiple group comparisons: P-value<0.05 is considered to be statistically significant. P-value<0.05, ***P-value<0.001, NS – Statistically non-significant.

The findings were also in corroboration with the study done by Kokich et al, where the perceptions were evaluated for images with modified gingival margins of maxillary central incisors and found similar results.[24]

In an earlier study, symmetrical alterations were evaluated in the gingival margins of the maxillary central incisors, which was also conducted by Kokich et al, where they similarly concluded that orthodontist could detect minor gingival alterations compared to laypeople.[25]

Thus, to the author's best knowledge, all the authors evaluating the smile esthetics through the perception of observers have established the same conclusion, that orthodontists are very prompt in detecting minor gingival changes compared to general dentists and laypeople being the least sensitive in detecting/recognizing these changes. From the overall ratings in the present study, in general, orthodontist assigned the least scores to the various images followed by general dentist and laypeople. Hence, proving the fact that orthodontists are critical in evaluating the smiles compared to the other two groups.

A critical aspect to note is that these findings may influence patient decisions during orthodontic treatment. Irregularities between the maxillary canine gingival margins can occur for a variety of causes, including anatomical variances, morphological abnormalities and over eruption leading to tooth wear, gingival hyperplasia or recession, canine substitution by premolars, and so on. Because of a missing lateral incisor, a canine can replace it, and a premolar can replace a canine. In such cases, however, irregularities develop in the gingival margins of the premolar as compared to the contralateral canine. Extensive research in the past recommends several therapeutic possibilities in these circumstances, including periodontal plastic surgery,[15,26,27] incisal edge repair accompanied with intrusion,[26,28–30] or extrusion of the contralateral tooth and incisal grinding.[26]

According to the findings of the present study, before finalizing the further clinical treatment plan, the magnitude of the asymmetry between the gingival margins of the canines must be evaluated, since it may not be perceived by laypeople, and treatment may not be needed. Thus, the correction of minor gingival differences between the maxillary canines could represent an unnecessary concern by dental specialists rather than an esthetic need.[31,32]

This result is apparent when the views of orthodontists and laypeople are evaluated. Orthodontists were rigorous in their judgments in most cases and gave lower scores to all smiles with asymmetries above 1.0 mm, whereas in most cases, laypeople did not detect asymmetries of up to 1.5 mm between the canine gingival margins. This result is corroborated by other reports.[24,25,31-33] [24,25,31,32]

Thus, it is apparent that any decision must be communicated with the patient before and during the orthodontic treatment.

Even though this study attempted to focus on most of the aspects using standardized methodologies, it came to light that our study had limitations. The main limitation of this study is that the standard smile chosen for the study was that of a male, which would lead to biases in perceptional alterations based on the subject's gender. Following that, it was a 2D examination of a 3D subject. As a result, tooth movements could only be monitored and analyzed in two dimensions. Furthermore, given that the study consisted of digitally manipulated photos from a single person and the opinions of certain sets of evaluators, the conclusions should be interpreted with caution. As per Kokich et al, the subjectivity of perceptions and views about smile esthetics makes it difficult to analyze and customize the data procured from the study, in day-to-day clinical practice. [24]

Hence, it is important to discuss the findings with the patients having irregularities or defects in the canine's vertical position or gingival margins and later on finalize the preferred treatment plan.

5. Conclusion

1. All the three groups of evaluators considered standard smile and smile with the intrusion of 0.5 mm as the most attractive, in the high smile group, while standard and extrusion of 0.5 mm in the low smile group.
2. In general, orthodontists, general dentists and laypeople found extrusion and intrusion of 1mm as unattractive.
3. For altered gingival zenith levels, the most attractive smile was the one with 0.5 mm of increased GZL as perceived by orthodontists and general dentists, while for laypeople it was the standard smile.
4. The less attractive smiles in this group were the ones with 1 mm followed by 0.5 mm of decreased GZL of canines according to the orthodontists, while for general dentists they were the images with 1mm decreased GZL followed by 1 mm increased GZL. However, according to laypeople smiling images with 1mm increased followed by 1mm decreased GZL of canines were the least attractive smiles.
5. Orthodontists scored all the images more critically by giving lesser scores compared to the general dentists and laypeople.

All the group of evaluators did not show any significant differences in the esthetic perceptions of high and low smiles, i.e. with and without gingival margin exposure.

6. Ethical Aprroval

This Study was done after taking approval from the Institution Ethics Committee.

7. Source of Funding

None.

8. Conflict of Interest

None .

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