Vertical Lip Thickness and Gingival Display: Comparing the Perception of Dental Professionals and Laypersons in Nigeria

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Abstract

Background: The purpose of this study was to assess the effect of vertical lip thickness and gingival display on aesthetics of posed smile in Nigeria population.

Methods: Two images of female smiles were intentionally altered with a software program (Adobe Photoshop, CS5. 1990-2010, Adobe system incorporated). The alteration involved gingiva-to-lip relationship of the maxillary anterior teeth and vertical lip thickness. These altered images were rated by two groups, 30 in each group, the professionals and lay persons using a visual analogue scale.

Results: A smile with the largest vertical lip thickness was associated with attractiveness. The professionals associated less gingival display to attractive smile.

Conclusion: Gingival display and vertical lip thickness both affect the aesthetics of smile.

Key words: Aesthetics, gingival display, vertical lip thickness.

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Introduction

A pleasing smile involves a harmonious relationship among the teeth, the gingival scaffold and the lip framework.[1,2] The smile, in particular, plays a significant part in determining a first impression of an individual. Different factors affect the overall smile and aesthetics; these include the tooth colour, shape, position, quality of restoration and general arrangement of the dentition, especially of the anterior teeth, upper lip position, visibility of teeth, and amount of gingival display. Some authors,[1,3,4] classified smile into: high smile, average smile and low smile.

Some amount of gingival display on the smile is certainly acceptable and in many cases is even aesthetic and youthful appearing. Conversely, a complete lack of gingival display is considered not as attractive.[5] Aesthetics is synonymous with a natural harmonious appearance.[2,3] Specific aspects of smile have been related to aesthetics and it has been found that how the teeth relate to the curvature of the lip and the amount of gingival display can also affect the aesthetics of smile.[6,7,8]

Attractive faces tend to have relatively wide, large mouths with full vermilion dominating the orolabial area, the upper lip protruding more than the lower lip vermilion and relatively narrow philtrum.[9] Husley,[6] demonstrated that the most attractive smiles are those with the upper lip at the height of the gingival margin of the maxillary central incisor.[7,8,10]

Facial appearance is judged largely on soft tissue contours, not hard tissue relationships. Particularly, others do not perceive the relationship of the dentition to the underlying bony structure. Both the upper and the lower lips have marked effect on the beauty of the smile. The higher the upper lip is elevated when smiling the more visible the teeth and the gingivae and the greater their role is in the aesthetic value of the smile[11]. Scott et al,[9] reported that white female preferences over the last century have tended towards increased lip prominence relative to the nose and the chin with no significant proportional changes in profile superior to subnasale or in the relationship of the chin to the upper face.[12] It has also been demonstrated that attractive white women have more protrusive lips than their less attractive cohort.[9]

The upper vertical lip thickness (UVLT) is the vertical distance from the superior point of the Cupid's bow to the most inferior portion of the tubercle of the upper lip.[1,13,14] The upper lip to tooth relationship is in the range of 1-5mm, women show

more within this range. Thick upper lip exposes less incisor than thin upper lip, all other factor being equal.[15] The upper lip position can be of three types –a high smile, which reveals 100% of the maxillary anterior teeth, and up to 1.5mm gingival tissues, an average smile, this displays 75 -100% maxillary anterior teeth and interproximal gingival tissue only, and a low smile, this displays less than 75% of the anterior teeth.[10,11,17]

The lower vertical lip thickness (LVLT) is the vertical distance from the deepest midline point on the superior margin of the lower lip to the most inferior portion of the lower lip.[1,13,14] The lower lip is measured from lower lip superior to the soft tissue menton.

The size and visibility of the teeth and upper lip position were critical factors in the self-perception of smile attractiveness; therefore the aim of this study was to assess the effect of vertical lip thickness and gingival display on smile aesthetics.

Materials and Methods

This was a cross-sectional descriptive study. Two images of female smiles were intentionally altered with a software program (Adobe Photoshop, CS5. 1990-2010, Adobe system incorporated). This involved incremental alteration in the gingiva-to-lip relationship of the maxillary anterior teeth and vertical lip thickness (Figure 1&2). These altered images were rated by two groups, 30 in each group, the professionals (general dentists, orthodontists, oral surgeons, restorative dentists, pathologists and periodontists) and lay persons using a visual analogue scale. A total number of 60 questionnaires were sent to the two groups by e-mail and hard copies

Figure 1

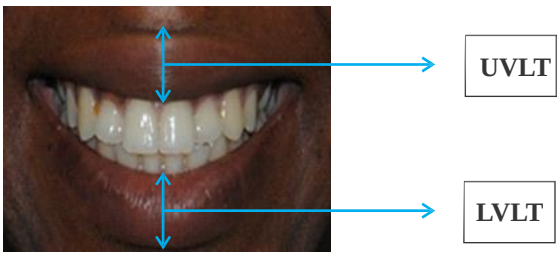

Figure 1: Vertical Lip Thickness

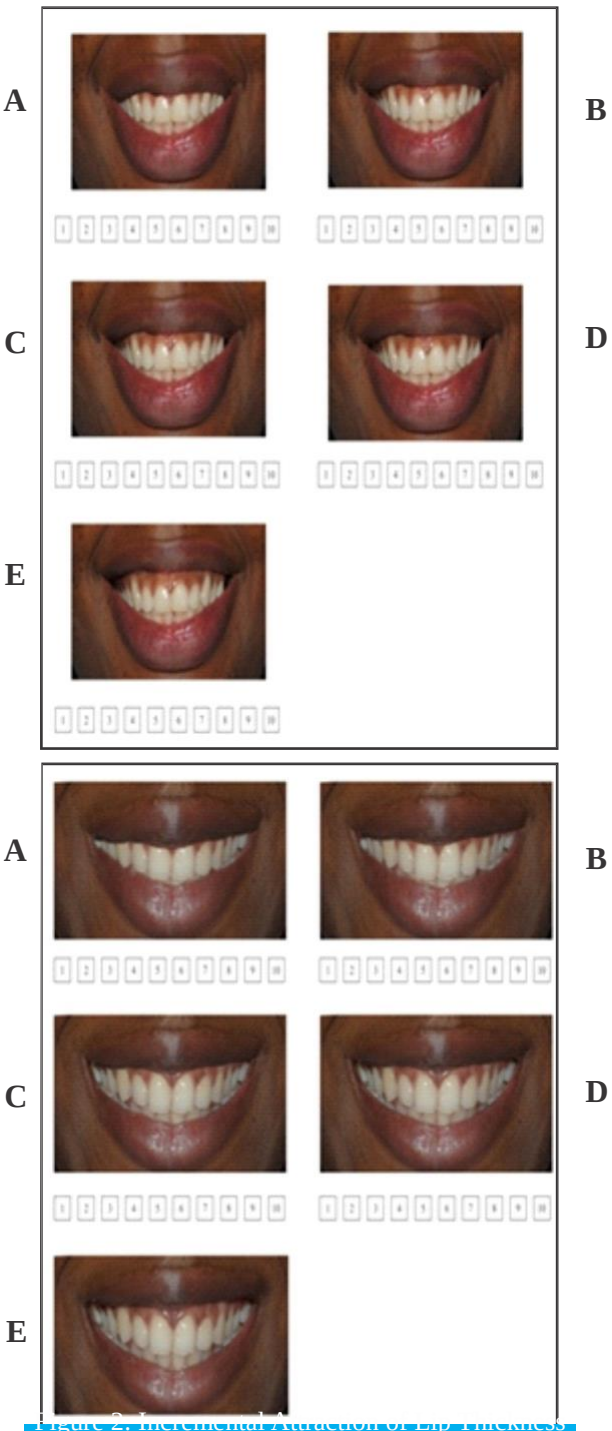

Figure 2: Incremental Alteration of Lip Thickness

and the response rate was 100%. Each smile with 4 variables was presented on each page of the questionnaires, arranged in two columns. Rating was carried out using a 10cm visual analogue scale for each smile. The following inclusion criteria were strictly followed, 1) no previous orthodontic treatment or oral and maxillofacial surgery, 2) complete permanent dentition except for third molars with no missing teeth or supernumerary teeth,

3) overjet of 2-4mm and normal overbite, 4) no active periodontal disease, 5) normal upper lip length, 6) no craniofacial anomalies or other pathologies, 7) no severe malocclusion 8) no canting of the maxillary occlusal plane.

Ethical clearance was approved by ethical committee of Lagos University Teaching Hospital. A letter of permission was granted by the University College Hospital, Ibadan and informed consent was signed and obtained from each subject.

Statistical Analysis

The mean, standard deviation and P value were calculated for each parameter. Overall mean for the various soft and hard tissue measurements was calculated. The 1-way ANOVA for comparison between the laypersons and the professionals, and also among the professionals was also calculated. The association between smile perception categories and the type of respondent was calculated. The smiles were scored using a 10mm visual analog scale, where ≤3=most attractive; 3-4.9=attractive; 5-6.9=average; ≥7=least attractive.

Results

Vertical lip thickness

The raters (Tables I&II show gender and perception according to layperson and professional) preferred smiles with reduced vertical lip thickness as seen in table III (4.2 ± 2.5 and 3.8 ± 2.3), here the vertical lip thickness were reduced by 2mm and1.5mm respectively. But amongst the professionals, the orthodontists were able to recognize the smile with increased vertical lip thickness and scored it 3.0 ± 1.2mm (Attractive), table IV

Table I: Distribution of Rates by Sex

	Laypersons	Professionals	Total	
Sex	No (%)	No (%)	No (%)	
Male	16(53.3)	12(40.0)	28(46.7)	$X^2 = 1.1$
Female	14(46.7)	18(60.0)	32(53.3)	p = 0.300
Total	30(100)	30(100)		

Gingival display

The smile with 1mm gingival display was given the best score of 4.4±2mm by the professionals while the laypeople gave the best score to the smile with 2.5mm 0f gingival display (4.2±2.4mm). There was no statistically significant difference. (P-value 0.209) table V.

About 25% of the professionals scored the smile with no gingival displayed most attractive and 31% of the laypersons scored the smile with 2.5mm of gingival display most attractive, table VI.

Discussion

For some individuals, the high smile line is characterized at its fullest by the exposure of a contiguous band of gingivae superior to the maxillary anterior teeth and often posterior teeth. In orthodontics and surgery, the gingival smile line or gummy smiles provokes stronger concern from clinicians than a low smile line, one that conceals the gingivae and part of the maxillary anterior teeth.[10,18]

The laypersons in this study seem to prefer smiles with gingival display. There was a statistically significant difference in the rating of the smile with gingival display between the professionals and the laypeople. Orthodontists, general dentists and the oral surgeons were more discriminating. They were able to distinguish between too little and no gingival display. In some studies, Orthodontists rated 2mm of visible gingivae as excessive and noticeably

Table II: Comparison Of Layperson and Professional By Their Perception of Vertical Lip Thickness Variable

Decrease in vertical lip thickness (mm)	Laypersons	Professionals		
A= no change	6.0 ± 3.0	4.8 ± 2.8	1.6	0.114
B= by 0.5mm	5.4 ± 2.5	4.1 ± 1.7	2.3	0.022
C= by 1.0mm	4.6 ± 2.3	4.0 ± 2.0	1.1	0.266
D= by 1.5mm	4.3 ± 2.5	3.8 ± 2.3	0.8	0.429
E= by 2.0mm	4.2 + 2.5	4.2 + 2.5	0.3	0.759

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Table III: Comparison of Mean Score of Vertical Lip Thickness Perception Among The Different Categories of Professionals

Decrease in vertical lip thickness (mm)	Gen Dent(1) Mean ± SD	Periodontist(2) Mean ± SD	O/Surgeon(3) Mean ± SD	O/Pathologist(4) Mean ± SD	Rest. Dent(5) Mean ± SD	Orthodontist(6) Mean ± SD	F test	P value
A=no change	5.4 ± 4.0	5.8 ± 2.9	3.5 ± 1.4	5.5 ± 2.4	6.2 ± 3.4	3.0 ± 1.2	1.2	0.339
B=by 0.5mm	4.4 ± 2.9	4.6 ± 1.1	3.8 ± 0.9	5.3 ± 2.5	3.6 ± 0.9	3.2 ± 1.3	0.8	0.529
C= by 1.0mm	4.2 ± 2.6	3.8 ± 1.1	4.0 ± 1.3	4.0 ± 4.1	3.6 ± 2.6	4.2 ± 0.8	0.1	0.998
D=by 1.5mm	2.8 ± 1.1	3.8 ± 2.3	3.8 ± 2.2	4.0 ± 4.1	4.0 ± 3.0	4.6 ± 1.7	0.3	0.921
E=by 2.0mm	2.2 ± 1.3	4.4 ± 2.9	3.7 ± 1.2	4.3 ± 3.9	5.2 ± 2.8	5.4 ± 2.6	1.1	0.399

Table IV: Association Between Vertical Lip Thickness Perception Categories and The Type of Respondent

	Laypersons					Professional						
Decrease in vertical lip thickness (mm)	MA (%)	A (%)	AV (%)	LA (%)	Total	MA (%)	A (%)	AV (%)	LA (%)	Total	X^2	P value
A=no change	4(13.3)	8(26.7)	3(10.0)	15(50.0)	30(100)	7(23.3)	9(30.0)	6(20.0)	8(26.7)	30(100)	4.0	0.267
B=by 0.5mm	2(6.7)	12(40.0)	5(16.7)	11(36.7)	30(100)	5(16.7)	15(50.0)	8(26.7)	2(6.7)	30(100)	8.5	0.036
C= by 1.0mm	8(26.7)	6(20.0)	9(30.0)	7(23.3)	30(100)	6(20.0)	14(46.7)	7(23.3)	3(10.0)	30(100)	5.3	0.149
D=by 1.5mm	8(26.7)	11(36.7)	4(13.3)	7(23.3)	30(100)	10(33.3)	10(33.3)	7(23.3)	3(10.0)	30(100)	2.7	0.442
E=by 2.0mm	11(36.7)	7(23.3)	5(16.7)	7(23.3)	30(100)	8(26.7)	12(40.0)	4(13.3)	6(20.0)	30(100)	1.9	0.577

MA = Most attractive,< 3, A = Attractive ; 3-4.9, AV= Average, 5-6.9, LA = Least Attractive;>7.

Rt; right, Lt; left

Table V: Comparison of Layperson And Professional By Their Perception of Gingival Display Variable

Increase in gingival display (mm)	**Laypersons** Mean ± SD mm	**Professionals** Mean ± SD mm	T test	P value
A= no gingival display	5.5 ± 2.8	4.6 ± 2.3	1.4	0.171
B=1.0mm gingival display	5.2 ± 2.7	4.4 ± 2.1	1.3	0.209
C=2.0mm gingival display	4.4 ± 2.2	4.7 ± 2.0	0.4	0.680
D=2.5mm gingival display	4.2 ± 2.4	5.0 ± 2.5	1.1	0.263
E=3.0mm gingival display	5.0 + 3.1	5.3 + 3.1	0.4	0.693

unattractive.[5] Chiche and Pinault[18], stated that the aesthetically ideal amount of visible gingivae is about 1mm. This is in agreement with report of Van Der Geld et al,[11] on both posed and spontaneous smiles in the Netherlands and smiles which showed some gingival display were perceived as most aesthetic. Kokich et al,[19] in a study of smiling photographs that were digitally altered, reported that 2-3mm of gingivae may be aesthetically acceptable. The present study showed that there is a significant difference in aesthetic perception of "gummy smile" between the laypersons and the professional raters.

Table VI: Comparison of Mean Score of Gingival Display Perception Among The Different Categories of Professionals

	Gen Dent (1)	Periodontist (2)	O/Surgeon (3)	O/Pathologist (4)	Rest. Dent (5)	Orthodontist (6)		
Increase in gingival display (mm)	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	F test	P value
A= no gingival display	3.0 ± 1.9	5.8 ± 1.3	3.8 ± 2.1	4.0 ± 0.0	7.0 ± 2.4	3.6 ± 2.5	3.1	0.029
B=1.0mm gingival display	3.6 ± 1.5	5.2 ± 1.9	4.8 ± 1.7	4.3 ± 0.9	4.4 ± 3.8	4.4 ± 1.9	0.3	0.919
C=2.0mm gingival display	3.6 ± 1.5	5.6 ± 2.5	4.0 ± 1.4	3.0 ± 1.4	6.6 ± 1.5	4.8 ± 1.6	2.8	0.044
D=2.5mmgingival display	5.0 ± 2.4	4.8 ± 3.2	4.3 ± 0.9	3.8 ± 3.1	6.0 ± 3.1	5.6 ± 1.9	0.5	0.805
E=3.0mm gingival display	5.6 ± 3.3	4.2 ± 3.6	4.5 ± 2.1	3.8 ± 1.3	7.4 ± 3.9	6.0 ± 2.8	0.9	0.493

Table VII: Association Between Gingival Display Perception Categories and The Type of Respondent

	Laypersons					Professional						
Increase in gingival display (mm)	MA (%)	A (%)	AV (%)	LA (%)	Total	MA (%)	A (%)	AV (%)	LA (%)	Total	X^2	P value
A= no gingival display	6(20.7)	6(20.7)	6(20.7)	11(37.9)	29(100)	7(25.0)	8(28.6)	7(25.0)	6(21.4)	28(100)	1.9	0.595
B=1.0mm gingival display	6(20.7)	6(20.7)	8(27.6)	9(31.0)	29(100)	4(14.3)	11(39.3)	8(28.6)	5(17.9)	28(100)	2.9	0.392
C=2.0mm gingival display	5(17.2)	11(37.9)	9(31.0)	4(13.8)	29(100)	4(14.3)	10(35.7)	9(32.1)	5(17.9)	28(100)	0.3	0.969
D=2.5mmgingival display	9(31.0)	8(27.6)	8(27.6)	4(13.8)	29(100)	5(17.9)	9(32.1)	4(14.3)	10(35.7)	28(100)	5.1	0.165
E=3.0mm gingival display	6(20.7)	10(34.5)	3(10.3)	10(34.5)	29(100)	6(21.4)	8(28.6)	4(14.3)	10(35.7)	28(100)	0.3	0.951

MA = Most attractive,< 3, A = Attractive ; 3-4.9, AV= Average, 5-6.9, LA = Least Attractive;>7.

Rt; right, Lt; left

In general, when a low smile line is determined, intrusion therapy in adolescents should be avoided as this will lead to a premature aged oral appearance and tooth display will be even more reduced by sagging of the lips in middle age.[11,21,22] Treatment of very high upper lip line (severe gummy smiles) may require surgical impaction of the entire maxilla (Le Fort 1) or of only the anterior part [21,22] (segmental osteotomy). To lengthen the upper lip, a V-Y cheiloplasty can be done or Botox injection, which mechanically reduces lip elevation, can be used as a temporary improvement.[22,23,24] If an average smile line height is determined, orthodontic intrusion should also be avoided.[11]

The orthodontists, the oral surgeons and about 13% of lay persons were able to appreciate the aesthetic effect of increased vertical lip thickness on smile compared to other professionals. Both groups of raters seem to prefer smiles with reduced vertical lip thickness. The mean vertical lip thickness for this study group, 14.2±2.1mm (upper lip), 16.0±2.0 (lower lip) for males and 13.0±2.5mm (upper lip) and 15.0±2.1mm (lower lip) for the females, is higher than those reported by Andrade de-Freitas et al,[24]. They carried out a study on comparison of skeletal, dentoalveolar and soft tissue characteristics in white and black Brazilian subjects. They concluded that thickness of the upper and lower lips was unexpectedly similar in both groups, but the black group showed more lip protrusion.[25] Peck and Peck,[10] found that compared to orthodontists, laypeople preferred lip profile that were more protrusive. Singh,[25] found comparatively fuller lips were preferred for class II and class III profiles when compared with class I profiles. These findings indicate that there is an agreement between the professionals and the laypeople in choosing the preferred smile; however their opinions differ in certain cases. McNamara et al,[13] stated that upper vertical lip thickness was important in the

determination of the attractiveness of the smile. The vertical thickness of the upper lip was correlated significantly with the maxillary incisor protrusion relative to the maxilla. This finding agrees with the clinical observation that flared maxillary incisors have a tendency to roll the upper lip up and out, exposing more of the mucocutaneous lip and increasing the vertical height of the exposed vermilion border of the lip. They also reported that lip thickness is positively correlated to incisor protrusion.[13] Oliver,[26] found that patients with thin lips or high lip strain displayed a significant correlation between incisor retraction and lip retraction whereas those with thick lips or low lip strain displayed no such correlation. Therefore, the impact of incisor retraction on the soft tissues, especially the upper lip, can influence smile aesthetics negatively and must be considered by orthodontists when planning treatment for African Americans. The ratio of maxillary and mandibular incisor retraction to upper and lower lip retraction are 1.75:1 and 1.2:1 respectively.[27] The report from a study by Hayashida and colleagues,[27] was that a change in the upper lip of African Americans in response to tooth movement was relatively larger than that in Caucasians, this finding seemed contrary to that of Oliver,[26] who reported a smaller change in the upper lip.

Conclusion

Smile attractiveness is a set of features that must be considered in orthodontic treatment planning with the understanding that every aspect of the set is important in the final score of smile beauty. The smile variables under study in this population were obviously important to smile aesthetics.

The following observations were made

1. There was an agreement that smiles that include some gingival display are perceived as most aesthetic.
2. The laypersons preferred smile with the smallest vertical lip thickness while only the orthodontists and oral surgeons preferred smile with the largest vertical lip thickness.

Contributors

AMN was responsible for study design, data collection, statistical analysis, interpretation of results and critical review.

DOO was responsible for conceptualization of research topic, study design, critical review and editing.

UIL was responsible for conceptualization of research topic, study design, critical review and editing.

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Self

Conflict of interests

Nil

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