Morphology and personal perception of excessive gingival display in anterior maxillary teeth

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Abstract

Background: An appealing smile is essential for achieving facial harmony. It reflects one's personality, demeanor, confidence, and essence. The balance of three key components-teeth, gums, and lips contour-contributes to this harmonious expression, fostering comfort and self-assurance in social interactions. However, excessive gingival display, often referred to as a gummy smile, disrupts this balance, leading to aesthetic concerns and impacting psychological well-being and behavior. **Materials and methods:** A cross-sectional study involving 61 dental students with an anterior gummy smile measured anatomical dimensions related to their smiles in both resting and spontaneous smiling positions. Additionally, students were surveyed about their personal perceptions of their gummy smile condition. **Results:** In a resting position, the mean height of the midface third, at 59.42 ± 4.23 mm, was significantly less than that of the lower facial third, which measured 68.72 ± 4.80 mm ($p < 0.05$). The mean gap between the lips at rest was 4.90 ± 2.03mm, and the exposure of the upper central incisors averaged 3.79 ± 1.33 mm. Additionally, the upper lip length was at 21.69 ± 1.87 mm. During spontaneous smiling, the gingival display compared to the upper lip was 4.75 ± 1.00 mm, while the mobility of the upper lip was 6.70 ± 1.60 mm. Regarding personal perception, a gummy smile diminishes patients' self-awareness, resulting in negative emotional repercussions and impacting quality of life in specific domains, including psychological discomfort and disability. **Conclusion:** A gummy smile can significantly affect personal perception, emotional well-being, and overall quality of life. More comprehensive research is essential to develop effective treatment strategies that enhance patients' psychological health, boost their confidence, and improve their aesthetic satisfaction.

Keywords: *gummy smile, resting position, spontaneous smile, excessive gingival display, personal perception*.

1. INTRODUCTION

Excessive gingival display, also known as "gummy smile", refers to a condition where an excessive amount of gingiva is visible when a person smiles. During a spontaneous or natural smile, typically only a small portion of the gingiva, primarily the gingival margin along the upper teeth, is visible. However, individuals with excessive gingival display often reveal a significant portion of their gingiva, which can cover a considerable part of their teeth. The threshold for excessive gingival display may vary depending on individual factors such as facial anatomy, tooth size and shape, and cultural perceptions of smile aesthetics. Additionally, what is considered excessive may also depend on the individual's own perception and aesthetic preferences. While there is some variability in defining threshold of this, it is generally considered to be more than 2 millimeters of gingival display when smiling [1].

The etiology of excessive gingival display can be classified into three primary categories. Factors related to soft tissue include a short upper lip and a hyperactive upper lip. The typical length of the upper lip is approximately 22-24 mm in males and 20-22 mm in females, with a short upper lip commonly attributed to excessive gingival display [2]. Typically, in a resting position, the incisal display is 3 - 4 mm. During a spontaneous smile, the clinical crowns are exposed completely (10 - 11 mm). This indicates that the upper lip moves 6 - 8 mm from the resting position to a spontaneous smile. However, in cases of hyperactivity, the upper lip may move 1.5 to 2 times greater than normal [2]. In terms of dental factors, altered passive eruption is a significant contributor to aesthetic concerns, affecting all components of a harmonious smile. When the gingiva covers a portion of the clinical crown, it increases the amount of visible gingiva during smiling, alters the clinical crown-to-root ratio, and influences the position and contour of the gingival margin [3]. Meanwhile, dentoalveolar extrusion, characterized by excessive tooth eruption, typically occurs in two scenarios: insufficient occlusal contact or missing opposing teeth resulting in deep bite, and attrition (associated

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with over-eruption of the incisors) [2]. Among bone-related factors, vertical maxillary excess contributes to an increased lower facial third leading to the long face syndrome [1].

In addition to the primary causes mentioned, a gummy smile can also arise from gingival hyperplasia, which is a clinical manifestation of plaque-induced gingivitis [4]. This condition involves swelling of the free gingiva, leading to an increased gingival size that covers part of the clinical crown, resulting in excessive gingival display. Additionally, hereditary gingival fibromatosis, a rare benign condition, is characterized by slow, progressive enlargement of the gingiva [5].

Excessive gingival display can affect an individual's self-confidence and may lead to aesthetic concerns. Treatment options vary depending on the underlying cause and may include orthodontic treatment, gingival contouring surgery, botox injections, or orthognathic surgery [1]. As society evolves and patients increasingly seek aesthetic enhancements, excessive gingival display has emerged as a factor impacting both quality of life and psychological well-being. Individuals often experience feelings of insecurity and embarrassment during their everyday communications. Therefore, this study aims to explore the morphological features and evaluate personal perceptions of excessive gingival display in the anterior maxillary teeth.

2. MATERIALS AND METHODS

2.1. Data acquisition

The study collected data from 453 students from first-year to sixth-year at the Faculty of Odonto-Stomatology, Hue University of Medicine and Pharmacy, aged 18 - 25. Among them, 61 students (13.47%, including 15 males and 46 females) exhibited a gingival display of more than 2 mm during a natural smile, indicating excessive gingival display.

To assess the morphology of excessive gingival display, we employed a standardized photography technique described as follows: students sat comfortably in a chair with a natural head position, eyes looking straight into the lens, and lips in a relaxed position. Hair was tied up or pulled back to expose the hairline and ears, and glasses were removed if applicable.

Regarding the camera setup: The ideal position of the camera was at the same height as the student's eyes. The focal point was the midpoint between the edges of the upper central incisors, ensuring equal distance to both corners of the mouth. The distance from the camera to the student was kept consistent for each shot; thus, the camera was mounted on a tripod approximately 1.5 meters away from the student, with a focal length of 55 - 70 mm, ensuring a 1:1 ratio. The tripod allowed for height adjustment, and the camera settings (aperture and shutter speed) were adjusted automatically according to the room lighting.

To capture spontaneous smiles, students were shown humorous videos or engaged in light-hearted conversation to elicit natural smiles, and the most natural smile, revealing all six upper anterior teeth, was then photographed.

After acquiring the images, the next step involved identifying the reference points on the standardized smiling photographs:

Table 1. Reference points on standardized smile images

Anatomical landmark	Notation
The point between the eyebrows and just above the bridge of the nose.	Glabella (G)
The point directly beneath the tip of the nose	Subnasale (Sn)
The lowest point of the chin	Soft tissue Menton (Me)
The midpoint of the lower vermilion border of the upper lip	Stomion superius (Stoms)
The midpoint of the upper vermilion border of the lower lip	Stomion inferius (Stomi)
The midpoint of the incisal edge of the central maxillary incisors	Labrale superius (Ls)

Using AutoCAD software to measure in the resting position:

Table 2. Variables on standardized smile images

Variable	Measurement	Unit
The midface third height	Distance between G and Sn	mm
The lower facial third height	Distance between Sn and Me	mm
The gap between the lips	Distance between Stoms and Stomi	mm

The upper lip length	Distance between Sn and Stoms	mm
The upper central incisor crown exposure	Distance between Stoms and Ls	mm
The mobility of the upper lip	Difference between the distance between Stoms and Ls at rest and during spontaneous smiling	mm
The gingival display compared to the upper lip	Distance between gingival margin and Stoms	mm

Figure 1. A: Camera setup for standardized photography
B, C: Capturing and photo analyzing at the rest
D, E: Capturing and photo analyzing during the natural smile

The assessment of aesthetic perception was collected through the Oral Aesthetic Subjective Impact Scale (OASIS) [6]. OASIS comprises 5 questions related to concerns about self-perception of oral appearance, answered on a Likert-type scale with scores: not concerned at all (1), somewhat concerned (3), and very concerned (5). Additionally, the Oral Health Impact Profile-14 (OHIP-14) questionnaire including 7 domains (functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap), with scores ranging from never (1), rarely (2), sometimes (3), often (4), to always (5) was evaluated the impact of a gummy smile on quality of life. The total OHIP-14 score is calculated by summing the scores from each domain, ranging from 0 to 56, with higher scores indicating poorer oral health-related quality of life [7].

Statistical analysis

Data are depicted as mean values and standard deviations ($\bar{X}$ ± SD).

Independent samples t-test was used to determine differences between mean values.

Cronbach's Alpha test was used to assess the reliability of the scale.

Tests were conducted with a confidence level of 95%, and statistical significance was concluded at $p < 0.05$.

3. RESULTS

Table 3. Morphological characteristics of a gummy smile

Dimension \ Gender	Male	Female	Total	p
	$\bar{X}$ ± SD	$\bar{X}$ ± SD		
The midface third height	62.16 ± 3.57	58.53 ± 4.08	59.42 ± 4.23	0.003
The lower facial third height	72.60 ± 5.57	67.45 ± 3.96	68.72 ± 4.80	0.001
The gap between lips	5.03 ± 2.21	4.86 ± 1.99	4.90 ± 2.03	0.780
The upper lip length	22.39 ± 1.80	21.47 ± 1.86	21.69 ± 1.87	0.097
The incisal display	3.64 ± 0.99	3.84 ± 1.43	3.79 ± 1.33	0.614

Table 4. Dimensions of spontaneous smiling

Dimension \ Gender	Male	Female	Total	p
	$\bar{X}$ ± SD	$\bar{X}$ ± SD		
The gingival display compared to the upper lip	4.80 ± 1.06	4.72 ± 0.99	4.75 ± 1.00	0.801
The mobility of the upper lip	6.61 ± 1.86	6.73 ± 1.52	6.70 ± 1.60	0.802

Table 5. Personal perception of a gummy smile in the anterior maxillary teeth

Personal perception of a gummy smile in the anterior maxillary teeth

Domain \ Gender	Male	Female	p	Corrected Item - Total Correlation
	$\bar{X}$ ± SD	$\bar{X}$ ± SD		
How do you feel about the appearance of your teeth?	3.2 ± 0.68	3.2 ± 0.91	0.986	0.427
Have you found that other people have commented on the appearance of your teeth?	3.07 ± 0.7	3.26 ± 1.06	0.424	0.624
Have you found that other people have teased you about the appearance of your teeth?	2.67 ± 0.9	2.87 ± 1.15	0.535	0.67
Do you try to avoid smiling because of the appearance of your teeth?	3.84 ±1.06	4.04 ± 0.84	0.511	0.383
Do you ever cover your mouth because of the appearance of your teeth?	3.87 ± 0.74	4.07 ± 0.85	0.424	0.418

Cronbach's Alpha=0.704

Impact of a gummy smile on quality of life

Table 6. Impact of gummy smile on quality of life

Domain \ Gender		Male	Female	p
		$\bar{X}$ ± SD	$\bar{X}$ ± SD	
Domain 1: Function limitation	Have you had trouble pronouncing any words because of problems with your teeth or mouth?	1.60 ± 0.74	1.72 ± 0.81	0.62
	Have you felt that your sense of taste has worsened because of problems with your teeth or mouth?	1.33 ± 0.49	1.63 ± 0.68	0.123
Domain 2: Physical pain	Have you had painful aching in your mouth?	2.27 ± 1.03	2.22 ± 1.03	0.873
	Have you found it uncomfortable to eat any foods because of problems with your teeth or mouth?	1.87 ± 0.64	2.13 ± 1.05	0.25
Domain 3: Psychological discomfort	Have you been self conscious because of your teeth or mouth?	2.87 ± 1.36	3.46 ± 1.35	0.146
	Have you felt tense because of problems with your teeth or mouth?	1.53 ± 1.06	3.22 ± 1.19	0.032
Domain 4: Physical disability	Has your diet been unsatisfactory because of problems with your teeth or mouth?	2.07 ± 0.88	2.07 ± 1.04	0.996
	Have you ever had to interrupt a meal because of your gummy smile?	1.93 ± 0.80	2.07 ± 0.9	0.616

Domain 5: Psychological disability	Have you found it difficult to relax because of problems with your teeth or mouth?	2.13 ± 0.99	2.24 ± 1.16	0.752
	Have you been a bit embarrassed because of problems with your teeth or mouth?	2.53 ± 0.99	2.91 ± 1.24	0.287
Domain 6: Social disability	Have you been a bit irritable with other people because of problems with your teeth or mouth?	1.93 ± 0.80	2.3 ± 1.31	0.197
	Have you had difficulty doing your usual jobs because of problems with your teeth or mouth?	1.93 ± 0.88	1.98 ± 1.11	0.887
Domain 7: Handicap	Have you felt that life in general was less satisfying because of problems with your teeth or mouth?	2.27 ± 1.03	2.28 ± 1.19	00.963
	Have you been totally unable to function because of problems with your teeth or mouth?	1.47 ± 0.64	1.63 ± 0.74	00.446
Total		14.73	17.85	

4. DISCUSSION

Morphological characteristics of a gummy smile

In this study, we examined 453 dental students aged 18 to 25, with 61 ones diagnosed with excessive gingival display, defined as at least 2 mm of gingival exposure when smiling naturally, in the maxillary anterior teeth group. Regarding morphological characteristics, anatomical dimensions were recorded in two states: rest and spontaneous smile.

The face is typically divided into horizontal thirds. The upper third spans from the hairline to the glabella, the middle third extends from the glabella to the subnasale, and the lower third ranges from the subnasale to the soft tissue menton. However, these divisions often vary in length. Among Caucasians, the middle third is usually shorter than the upper third, and both the middle and upper thirds are generally shorter than the lower third. Conversely, in East Asians, the middle third of the face tends to be longer than the upper third and comparable to the lower third, while the upper third is shorter than the lower third [8]. However, in this study, the mean lower facial third length was 68.72 ± 4.80 mm, significantly greater than that of the middle third with 59.42 ± 4.23 mm. The maxillary vertical excess, characterized by hyperdivergent growth, is a common cause of excessive gingival display, resulting in a clinical appearance known as “long face syndrome”. Schendel was the pioneer in introducing the term “long face syndrome” in literature. It denotes maxillary vertical excess, commonly characterized by hyperdivergent growth. This condition leads to an enlarged lower facial third, thus giving rise to the appearance of a long face [9].

The upper lip length, measured from the subnasale to the upper lip stomion at rest, is typically between 22 - 24 mm in young adult males and 20 - 22 mm in young adult females. A short upper lip is defined when this measurement is less than 20 mm in males and 18mm in females [2]. In our study of individuals with excessive gingival display, the average upper lip length for males and females was 22.39 ± 1.80 mm and 21.47 ± 1.86 mm, respectively, falling within the normal reference range. Regarding the gap between the lips in the resting position, a normal range is typically between 1 to 3 mm. However, in individuals with excessive gingival display, there was an increased gap between the lips at rest, measuring 4.90 ± 2.03 mm. This increase may be due to abnormalities in bone and teeth development or changes in upper lip anatomy or function.

The incisal display relative to the upper lip in male and female subjects was 3.64 ± 0.99 mm and 3.84 ± 1.43 mm, respectively, with no statistically significant difference. However, a study in Italy, recorded from the pretreatment orthodontic records, found that the incisal display at rest was 3.72 ± 2.69 mm in males and 4.77 ± 2.24 mm in females, with this difference being statistically significant [10]. Additionally, a study on an Asian population suggested that the common guideline of 2 mm incisal display at rest may only be suitable for patients with a straight lip form, while those with moderate or high lip forms may require 4 or 5 mm of incisal display at rest, respectively [11].

In a study conducted by Kokich et al., different levels of gingival exposure were manipulated, ranging from 2,4 to 6 mm, and covered to the same extent. The evaluators included orthodontists, general dentists, and laypersons. The findings revealed that gingival exposure of up to 4 mm was deemed acceptable by the latter two groups, whereas orthodontists considered exposure exceeding 2 mm to be aesthetically unpleasing [12]. Similarly, in Japan, smiles featuring more than 3 mm of gingival display were deemed unattractive. Multiple Indian studies also indicated that the maximum acceptable tolerance for gingival display was less than 2 mm. In Arabic populations, particularly in Jordan, a study assessing various components of smiles identified 2 mm of gingival display as the threshold for an esthetically pleasing smile. Likewise, a study conducted in Saudi Arabia found that smiles with the gingival display of 1 mm or more were not perceived as attractive. Furthermore, comparisons between the perceptions of dental students and laypeople indicated that students had a heightened sense of dental aesthetics [13]. The prevalence of gummy smile in this study was 13.47%, which may differ from other studies possibly due to variations in the threshold for defining a gummy smile as well as differences in racial backgrounds. The mean gingival display in males and females was 4.80 ± 1.06 mm and 4.72 ± 0.99 mm, respectively, with no statistically significant difference.

During a smile, the upper lip rises to reveal the maxillary incisors. The symmetrical movement ensures a balanced display, which is considered aesthetically pleasing. Women tend to have greater lip mobility than men, and they are more prone to excessive lip mobility. This excessive mobility can lead to an overly gummy smile during full smiles, even with a normal lip length [14]. The average spontaneous lip excursion is 6-8mm above resting position when smiling. However, in patients with upper lip hyperactivity, this distance may increase by 1.5 to 2 times. This study found that the average lip mobility, which falls within the normal range, is 6.61 ± 1.86 mm for males and 6.73 ± 1.52 mm for females, with no statistically significant difference.

Personal perception of a gummy smile in the anterior maxillary teeth

In this study, we conducted a survey among dental students, a population that not only falls within the young adult age group but is also known for its increasing awareness of aesthetics and self-image. The OASIS questionnaire, which has been validated as appropriate for young adults, was therefore a suitable tool for assessing their perceptions [6]. Given their educational background and professional orientation, dental students are more likely to pay attention to appearance-related factors, making them a relevant and insightful group for this type of research.

Table 5 shows that there were no statistically significant differences ($p > 0.05$) between male and female participants in their personal perception of a gummy smile in the anterior maxillary region across all items. Both genders expressed similar levels of concern regarding the appearance of their teeth, reports of others commenting or teasing them, as well as behavioral responses such as avoiding smiling or covering the mouth. The internal consistency of the scale was acceptable, with a Cronbach's alpha of 0.704, indicating that the items were reasonably correlated and measured a coherent construct. Notably, the items related to social feedback-specifically being commented on (item 2; corrected item-total correlation = 0.624) and being teased (item 3; $r = 0.670$) - showed the strongest associations with the overall score, suggesting that social interactions may significantly influence self-perception of dental aesthetics. These findings are consistent with those of Van der Geld et al. (2007), who reported that dissatisfaction with one's smile was often more closely linked to external social feedback than to one's own internal evaluation [15]. Therefore, psychosocial factors should be considered when assessing the psychological impact of a gummy smile, especially in planning aesthetic dental interventions.

Impact of gummy smile on quality of life

The analysis of the impact of a gummy smile on quality of life, measured through multiple domains of the Oral Health Impact Profile, revealed a general trend of higher perceived impact among female participants compared to males across almost all dimensions. However, most differences were not statistically significant ($p > 0.05$), indicating relatively similar experiences between genders. The only item reaching statistical significance was in the domain of psychological discomfort, where females reported feeling significantly more tense due to problems with their teeth or mouth than males (mean = 3.22 vs. 1.53; $p = 0.032$). This suggests that psychological burden associated with dental appearance - particularly a gummy smile - may affect females more profoundly, potentially due to higher aesthetic expectations or social pressures regarding appearance. While other domains such as self-consciousness, embarrassment, and irritability

also showed higher mean scores in females, the differences did not reach statistical significance. These findings are partially consistent with those of Silveira et al. (2021), who found that women were more likely to report emotional and social impacts related to dental aesthetics, including smile line and gingival display [16]. The total score in this study was higher in females (17.85) than in males (14.73), reinforcing the trend of greater perceived quality-of-life impact in women.

Although a gummy smile does not appear to severely impair physical functioning or cause significant pain, it may have a notable psychological and emotional impact, especially among females. These results highlight the importance of considering gender-specific concerns when planning aesthetic or corrective interventions for gummy smile, particularly in relation to patients' self-esteem and psychological well-being.

In conclusion, the smile is considered one of the most crucial expressions, greatly influencing facial attractiveness. A pleasing and attractive smile not only boosts an individual's acceptance in society but also enhances interpersonal relationships. With patients growing more aware of their dental appearance, achieving optimal smile aesthetics has become the foremost goal of dental treatment. In this study, besides providing morphological characteristics of a gummy smile, the research also revealed personal perceptions about it, where patients tend to conceal their smiles or even avoid smiling. Regarding quality of life, both males and females experience the negative impacts of a gummy smile, the psychological and social dimensions are particularly significant, especially for females. This underscores the importance of addressing aesthetic concerns and providing appropriate psychological support to individuals affected by a gummy smile. Hence, both physical and psychological interventions are needed not only to improve aesthetics but also to achieve psychological comfort and confidence in daily life.

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