

## RESEARCH ARTICLE

# Layperson's Esthetic Preference to the Presence or Absence of the Interdental Papillae in the Low Smile Line: A Web-based Study

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## Abstract

**Purpose:** To determine the layperson's esthetic preference to the visual display (presence) or lack thereof (absence) of the interdental papillae during minimum smiling or the low smile line patient type.

**Materials and Methods:** Two hundred lay-people were shown three-paired smile images indicative of a low gingival smile line patient type in which the vermillion border of the maxillary lip covered the mid-facial gingiva of the anterior teeth. The three images differed only with respect to [1] presence of interdental papillae, [2] absence of the interdental papilla ("black triangle"), or [3] absence of the interdental papillae (replaced with a long restorative contact area). The three images were paired in multiple groupings; group-1 consisted of a comparison of the presence of interdental papillae vs the lack of the interdental papillae "black triangle," group-2 compared the long restorative contact compared to the presence of the interdental papillae and Group-3 compared the long restorative contact replacing a missing papilla to the absence of the interdental papillae "black triangle." The comparisons were designed to determine the subjective preference of lay individuals between these groupings.

**Results:** Ninety-eight percent of lay-people demonstrated a preference to the presence of the interdental papillae in the smile (image 1) when compared to its absence ("black triangle"; image 2) with a low smile line. Seventy percent preferred the visual display of the interdental papillae, that is, pink tissues (image 1), compared to the absence of the interdental papillae replaced with a long contact area (image 3), that is, white restorative materials, when viewing a low gingival smile line. And when comparing the absence of the interdental papillae "black triangle" to a long contact area, 92% of lay-people preferred a long contact area vs the absence of the interdental papillae with a "black triangle" with a low smile line.

**Conclusions:** The visual display [presence] of the interdental papillae, that is, pink tissues, is notably preferred to the absence of the interdental papillae when replaced by either a "black triangle" or long contact area in the commonly known low smile line. This emphasizes the need to assess the Interdental Smile Line (ie, visual display of interdental papillae during smiling) in all patients and the importance to preserve

and/or re-establishment of the interdental papillae, that is, pink tissues, even in patients with a low smile line.

#### KEYWORDS

dental esthetics, high interdental smile line, high smile line low smile line, interdental papillae, low interdental smile line, mid-facial gingiva, patient perception, visual display

## 1 | INTRODUCTION

Patient satisfaction to dental treatment can be assessed by a myriad of clinical factors that can include absence of disease, lack of pain, improved occlusal function, and dental esthetics. The subjective nature of dental treatment, in particular, esthetics can often times present the clinician with significant challenges when attempting to provide "successful treatment" when viewed through the subjective eyes of the patient. Esthetic dentistry demands a detailed clinical assessment and documentation with effective communication between clinician and patient and these become key elements to understanding treatment outcomes and expectations. Therefore, successful esthetic outcomes require a thorough smile analysis as a critical component to diagnosis and treatment.

Previous studies on the smile line have focused on the amount and location of tooth and mid-facial gingival display relative to the upper lip.<sup>1-4</sup> Tjan et al. created a smile guideline in dentistry in the mid-80s that was widely accepted and used.<sup>2</sup> Their research classified smiles into three basic categories, *High*, *Average*, and *Low* according to the exposure of the clinical crown cervical margin relative to vermillion border of the upper lip. The majority of these patients (69%) fell within the category of the *average* smile line defined as 75%-100 % of tooth exposure when smiling. In this study 11% of subjects were found to reveal the entire clinical crown with a contiguous band of gingiva mid-facially hence categorized as the *high* smile line patient. The *low* smile line category found in 21% of the patients represented a smile displaying less than 75% of the clinical crown.

Van der Geld et al. studied 122 men to evaluate self-perception of smile attractiveness.<sup>5</sup> They reviewed the smile characteristics of upper lip position and visibility of gingiva, tooth color and shape, position, and visibility of teeth. Visibility of full teeth associated with mid-facial gingival display of 2-4 mm was found to be the most attractive. Patients revealed roughly 30% more tooth display during "spontaneous" vs "posed" smiling, this study however did not use the interdental papillae as a smile analysis criteria.<sup>5</sup>

An important consideration is the natural aging of the relationships between soft tissues and the dentition. Sarver and coworkers reported that increased age results in a significant reduction of the exposed clinical crown to the border of the upper lip during smiling of age groups evaluated between the second to fifth decades of life, thereby supporting the comments in the literature that a smile analysis should include the evaluation of the interdental papillae and not be

limited to mid-facial gingival display and/or the exposed clinical crown, particularly with increasing age.<sup>6</sup>

Passia, Blatz, and Strub recently conducted a systematic review of 309 articles in which nine studies fulfilled their selection criteria and were utilized to determine the acceptance of the universal applicability and validity of the smile line in the dental literature.<sup>7</sup> The studies selected were found to be consistent to the average smile and emphasized the importance of the smile line when restoring a patient's intraoral condition whether through direct or indirect restorations and stated that the clinician should aim for the most common parameters. In this same systematic review, four of the selected studies pertain to perception studies of smiles by lay-people, general dentists, and orthodontists. They concluded that orthodontists were typically more critical than lay-people or general dentists related to the parameters of the smile thereby supporting the concept that additional perception studies should be conducted on lay-people to determine attractiveness and desirable biases to patients' smile perception.

Hochman, Chu, and Tarnow in 2012 presented additional criteria to add to the previous high, average, and low smile line assessment that included a new awareness of the presence or absence of the interdental papillae display during smiling.<sup>8</sup> Two basic categories were defined; *High Interdental Smile Line (HISL)* or *Low Interdental Smile Line (LISL)*. The Interdental Smile Line is differentiated from a traditional smile line in that it has been historically based upon postural position of the vermillion border of the upper lip to the clinical crown length of the upper anterior teeth. The aforementioned study analyzed standardized clinical images of 420 patients from a frontal, right lateral, and left lateral view during maximum smile. The patient population ranged from 18 to 89 years old and included both genders. Ninety-one percent of all patients were found to display the interdental papillae (HISL) during smiling when the classical smile line groups of high, average, and low were evaluated. Additionally, it was reported that 87% within the low smile line group subset will display the interdental papillae, therefore, the interdental papillae is an important esthetic feature to identify during smile line assessments. The results demonstrated that the presence of interdental papillae in a low smile line patient is a commonly found clinical feature that is present in patients of all ages. And this should therefore dispel the misconception among clinicians that patients presenting with a low smile line have fewer esthetic demands due to the lack of visual display of these gingival tissues during smiling. Therefore, the need for adding an additional criteria to current smile line analyses is suggested. Furthermore, the presence or absence of the interdental papillae with a low smile line

**FIGURE 1** An illustration showing the presence of the interdental papillae of maxillary anterior teeth with a low smile line. A low smile line is defined as a smile in which any portion the clinical crowns of the maxillary anterior teeth are covered by the vermillion boarder of the maxillary lip



**FIGURE 2** An illustration of a low smile with the absence of the interdental papillae in which no restorative material has been placed into the "black triangle" to restore or recreate the interdental papillae



patient may ultimately impact the patient's perception of "success or failure" of the esthetic outcome of treatment.

Therefore, the objectives of this study were: (1) Determine if laypeople could differentiate between the presence or absence of the interdental papillae in a low smile line, and (2) Identify the laypersons preference between the following three clinical conditions; (a) presence of the interdental papillae, (b) absence of the interdental papilla ("black triangle"), or (c) absence of the interdental papilla replaced with a long interproximal contact area.

## 2 | MATERIALS & METHODS

An online Internet survey was performed via SurveyGizmo, an internet-based survey provider ([www.SurveyGizmo.com](http://www.SurveyGizmo.com)) the survey

was conducted between February to April 2013. Two hundred laypeople were randomly selected with a total of 114 females (57%) and 86 males (43%). The subjects ranged in age from 20 to 75, with a mean of 40 years old. Ethnicity and educational background of participants were also recorded. A single exclusion criterion was included in the survey questions where participants were asked "Is your job related to the dental healthcare profession?"

Professional medical illustrations of the smile line of patients in which the vermillion boarder of the maxillary lip extended coronally beyond to the free gingival margin and covered a portion of the clinical crown of the maxillary anterior teeth. This was to be defined as a low smile line patient in this study. Therefore, the low smile line patient is noted as one in which the direct labial gingival tissues are not displayed. Three different clinical variations with respect to the presence or absence of the interdental papillae were created.

**FIGURE 3** An illustration of a low smile with the absence of the interdental papillae in which a white restorative material is used to create a long contact area



Figure 1 shows the image shown for low smile line with presence of the interdental papillae. This smile displays the “pink” gingival tissues one would typically observe when papillae are present.

Figure 2 shows a low smile line with the absence of the interdental papillae with “black interdental triangles” representing a loss of the interdental papillae.

Figure 3 shows a third image with a low smile line with the absence of the interdental papillae replaced by a white restorative material, representing a loss of the interdental papillae replaced by long interproximal contact areas between these teeth.

The figures were paired (Figures 1 and 2; Figures 1 and 3; Figures 2 and 3) with one another in a series of three different permutations and displayed on the internet via SurveyGizmo so that direct comparison between each different image could be performed. A pool of randomly selected lay-individuals was recruited from three different dental practices. Participants were asked to log onto SurveyGizmo with a study specific web address that provided direct access to the research materials. They were asked to select the preferred smile from amongst each paired group via online instructions. No additional coaching or discussion occurred. A single selection was made by the participant for each paired group by activating a digital check-box. The data set was electronically tabulated and collected by SurveyGizmo and then downloaded by the researchers for further analysis. Group-1 consisted of a comparison of the presence of interdental papillae vs the lack of the interdental papillae “black triangle,” group-2 compared the long restorative contact compared to the presence of the interdental papillae and group-3 compared the long restorative contact replacing a missing papilla to the absence of the interdental papillae “black triangle.” This closed ended research design is termed a two-alternative forced choice study. Participants were asked to select, “Which smile you feel is more attractive?” A single answer was accepted for each pair of images viewed thereby allowing direct comparisons to be established between the three images.

This paired arrangement of the three different images allowed direct comparison to be achieved to measure and establish subjective lay-person preference of the three paired images.

Once all questionnaires were completed, the frequencies of the subject answers were determined to analyze the data.

### 3 | RESULTS

The 200 respondents were identified as lay-people since none of the 200 respondents identified their occupation as related to the dental healthcare profession.

Age: Age ranged between 20 to 75 years old with an average of 40.1 years.

Gender: Forty-three percent of the respondents were male and 57% female.

Ethnicity: Eighty percent were Caucasian, 14% Hispanic, with the remaining 6% of another ethnicity.

Educational Background: Fifty percent of participants were college educated, 35% held postgraduate degrees, with the remaining participants with associate degrees (ie, high-school or less).

Subjective Interdental Smile Line Preference: Ninety-eight percent lay-people surveyed preferred the presence of the interdental papillae (ie, pink tissue display) in the smile when compared to the absence of the interdental papillae (“black interdental triangles”) with a low smile line. When comparing the absence of the interdental papillae “black triangle” to a long contact area (ie, white restorative material) 92% of lay-people preferred a long contact area vs the absence of the interdental papillae with a “black triangle” with a low smile line. And, 70% preferred the visual display of the interdental papillae, that is, pink tissues compared to the absence of the interdental papillae replaced with a long contact area, when viewing a low smile line.

### 4 | DISCUSSION

Numerous studies have been conducted regarding subjective perception of the smile and its associated characteristics.<sup>9–12</sup> Kokich et al. was one of the first research teams to evaluate the subjective perception of a variety of smile characteristics including mid-facial gingival display, midline deviation, diastema, incisal angulation, and gingival embrasure.<sup>13,14</sup> Images shown that displayed greater than 4 mm of mid-facial gingival were found to be unattractive. It demonstrated variability between laypersons and dental professionals in which the orthodontist is more critical to variations in characteristics of the smile when compared to laypersons.<sup>14</sup>

The current study demonstrates that lay-people can identify the presence or absence of the interdental papillae even in the low smile line patient. The overwhelming patient preference of the presence of the interdental papillae in the smile to either the absence (“black triangle”) or long interproximal contact areas, 98% and 70%, respectively, demonstrates that this characteristic is not only highly noticeable to patients but also desirable. Of particular interest is the finding that when comparing “pink” to “white” in the area of the gingival embrasures, the presence of the papillae, represented by pink tissue was a preferred preference. A limitation of the study was an absence of ethnic diversity in the sample population, in which 80% of the respondents were Caucasian. It is possible that ethnicity may influence the effect on the perception of attractiveness of the gingiva/smile framework. This may represent an interesting area of investigation in the future.

There are several important clinical implications of this study and its findings. First, a comprehensive smile analysis should include documentation of the interdental papillae. Second, the misconception that treating a patient with a low smile line represents a lesser esthetic challenge owing to the lack of visual gingival display is erroneous as seen from the results of this study. It is these authors opinion that the presence of the interdental papillae, that is, “pink” tissue or pink restorative materials in the low smile line patient is an important characteristic that most patients desire to be present in a smile. The absence of the interdental papillae during smiling from patients with a low smile line is often the difference between a visually pleasing esthetic outcome vs an unattractive, “artificial” smile. Third, the clinical treatment of patients should include treatment options that re-establish or regenerate the missing interdental papillae. The use of

periodontal surgery as a predictable option has yet to yield consistent treatment outcomes. Orthodontic extrusion has been shown to provide a viable treatment option that may re-establish the lost interdental papillae in certain situations.<sup>8,15</sup> Therefore, orthodontic extrusion does represent a reasonable treatment option to address the absence of interdental papilla. The option of using “pink” dental materials such as pink ceramics or composites to simulate and recreate missing interdental papillae represents another treatment alternative to the loss of the interdental papillae in lieu of using white ceramic or composite restorative materials. The data collected in this study demonstrated a preference of pink restorative materials when compared to the long contact area created with white dental materials. These results identify that patients do have a preference when it comes to the presence or absence of the interdental papillae in a low smile.

## 5 | CONCLUSIONS

A web-based perception study concluded that the visual display of the interdental papillae is an important smile feature that is preferred in the overwhelming majority of patients receiving treatment. Preservation and/or re-creation of this anatomical structure whether biologically or restoratively should be given particular attention. The *Interdental Smile Line* is an important esthetic parameter in a smile evaluation and should be given consideration when performing a comprehensive smile line analysis.

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## DISCLOSURE STATEMENT

No conflict of interest.

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