

Esthetic perception of gummy smile with the application of botulinum toxin, via eye-tracking

Percepção estética do sorriso gengival com aplicação de toxina botulínica, via rastreamento do olhar

Percepción estética de la sonrisa gingival con la aplicación de toxina botulínica, mediante eye-tracking

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Abstract

We aimed to evaluate laypeople's visual perception of the gingival smile before and after botulinum-toxin application, using eye-tracking technology. Two frontal photographs of a female volunteer's face with a gingival smile were used. One before and another 30 days after the toxin application in the upper lip elevator muscle region. The images were evaluated by 58 participants. Using the OGAMA software, visualization data were obtained in three areas of interest (AOI) through eye-tracking. A visual analog scale (VAS) was used to assess facial attractiveness, and a questionnaire to assess the perception of sympathy, satisfaction with the smile, dissatisfaction with dental and gingival exposure, and shyness. Heat and point maps showed that the participants visually concentrated on the mouth region, with a small transition to the nose and eyes in the pre-procedure image. The mouth region was the AOI where the first visualization occurred in a shorter time compared to the latter areas ($p < 0.05$). VAS revealed that attractiveness increased in the image with less gingival exposure ($p < 0.05$). After the toxin application, satisfaction with the smile increased ($p < 0.05$), and dissatisfaction with gingival exposure decreased ($p < 0.05$). However, dissatisfaction with dental exposure increased ($p < 0.05$). We discovered that the mouth attracted greater attention from participants in less time compared to other AOI. The decrease in gingival exposure after the botulinum toxin application resulted in improved facial esthetics. There was a perceptible increase in "satisfaction with the smile" and a decrease in "dissatisfaction with gingival exposure." Conversely, the "dissatisfaction with dental exposure" increased.

Keywords: Smile; Botulinum Toxin Type A; Gingival display; Visual perception; Eye-tracking; Health teaching.

Resumo

O objetivo deste estudo foi avaliar a percepção visual do sorriso gengival de indivíduos leigos antes e após a aplicação de toxina botulínica, usando a tecnologia de rastreamento ocular. Foram utilizadas duas fotografias faciais frontais de uma voluntária do sexo feminino com sorriso gengival. Um antes e outro 30 dias após a aplicação da toxina na região do músculo elevador do lábio superior. As imagens foram avaliadas por 58 participantes. Utilizando o software OGAMA, os dados de visualização foram obtidos em três áreas de interesse (ADI) por meio de rastreamento ocular. Foi utilizada uma escala visual analógica (EVA) para avaliar a atratividade facial e um questionário para avaliar a percepção de simpatia, satisfação com o sorriso, insatisfação com a exposição dentária e gengival e timidez. Os mapas de calor e de pontos mostraram que a visualização dos participantes se concentraram na região da boca, com pequena transição para o nariz e olhos na imagem pré-procedimento. A região da boca foi a ADI onde ocorreu a primeira visualização em menor tempo em relação às últimas áreas ($p < 0,05$). A EVA revelou que a atratividade aumentou na imagem com menor exposição gengival ($p < 0,05$). Após a aplicação da toxina, a satisfação com o sorriso aumentou ($p < 0,05$) e a insatisfação com a exposição gengival diminuiu ($p < 0,05$). No entanto, a insatisfação com a exposição odontológica aumentou ($p < 0,05$). Concluiu-se que a boca atraiu maior atenção dos participantes em menos tempo em comparação com outras ADI. A diminuição da exposição gengival após a aplicação de toxina botulínica resultou em melhora da estética facial. Houve um aumento perceptível na “satisfação com o sorriso” e uma diminuição na “insatisfação com a exposição gengival”. Em contrapartida, a “insatisfação com a exposição dentária” aumentou.

Palavras-chave: Sorriso; Toxina Botulínica Tipo A; Gengiva. Percepção visual; Eye-tracking; Ensino em saúde.

Resumen

El objetivo de este estudio fue evaluar la percepción visual de la sonrisa gingival de los legos antes y después de la aplicación de la toxina botulínica, utilizando la tecnología de seguimiento ocular. Se utilizaron dos fotografías frontales del rostro de una voluntaria con sonrisa gingival. Uno antes y otro 30 días después de la aplicación de la toxina en la región del músculo elevador del labio superior. Las imágenes fueron evaluadas por 58 participantes. Usando el software OGAMA, se obtuvieron datos de visualización en tres áreas de interés (ADI) a través de eye-tracking. Se utilizó una escala analógica visual (EAV) para evaluar el atractivo facial y un cuestionario para evaluar la percepción de simpatía, satisfacción con la sonrisa, insatisfacción con la exposición dental y gingival y timidez. Los mapas de calor y puntos mostraron que los participantes se concentraron visualmente en la región de la boca, con una pequeña transición a la nariz y los ojos en la imagen previa al procedimiento. La región de la boca fue la ADI donde la primera visualización ocurrió en un tiempo más corto en comparación con las últimas áreas ($p < 0.05$). La EAV reveló que el atractivo aumentaba en la imagen con menor exposición gingival ($p < 0,05$). Después de la aplicación de la toxina, aumentó la satisfacción con la sonrisa ($p < 0,05$) y disminuyó la insatisfacción con la exposición gingival ($p < 0,05$). Sin embargo, aumentó la insatisfacción con la exposición dental ($p < 0,05$). Descubrimos que la boca atrajo más la atención de los participantes en menos tiempo en comparación con otras ADI. La disminución de la exposición gingival después de la aplicación de la toxina botulínica resultó en una mejora de la estética facial. Hubo un aumento perceptible en la "satisfacción con la sonrisa" y una disminución en la "insatisfacción con la exposición gingival". Por el contrario, aumentó la "insatisfacción con la exposición dental".

Palabras clave: Sonrisa; Toxina Botulínica Tipo A; Aparición gingival; Percepción visual; Enseñanza en salud.

1. Introduction

An esthetic smile is the result of a combination of different components, such as soft tissue, dental, and gingival exposure. This is one of the goals for dental treatments, as these components must balance with each other (Wang et al., 2018). The length of the upper lip, the size of the incisors, and excessive gingival exposure are factors that have the greatest impact on the smile (Albino et al., 1994). Specifically, the gingival smile, recognized as an esthetic problem, is influenced by all of these elements (Guo et al., 2011).

Lip movements control the amount of gingival exposure, dictating the composition of the smile. Thus, the visibility of the gingiva and the dental disposition are formed by the lip position and the height of the smile line (Flanary, 1992). A smile with more than 2 mm of gingival exposure can be seen as unsightly. Therefore, dissatisfaction with appearance is usually the main reason for seeking treatment (Kattimani et al., 2019), especially by women. This is because the prevalence of gingival smiles in women is twice as high as that of men (Tjan et al., 1984). This is often attributed to excessive contraction of the muscles of the upper lip. This is also a possible cause of the alteration of passive eruption pathways, vertical maxillary excess, anterior tooth-alveolar extrusion, and thin upper lip (Silberberg et al., 2009). A recommended treatment is botulinum toxin type A, which,

when applied in small doses, limits the contraction of the upper lip elevating muscles and maintaining the ability to smile (Jaspers et al., 2011). This makes it a minimally invasive intervention option to be considered in the treatment plan. (Polo, 2008).

Studies concerning the esthetics of the smile and its interference in facial attractiveness contribute to determining the need for intervention (Gasparello et al., 2022). Thus, this can be performed using different methodologies and perspectives (Chang et al., 2011; Moore et al., 2005; Parrini et al., 2016). Eye-tracking for visual perception analysis consists of assessing the position and movement of the eyes using an eye-tracking device, verifying the path that the eye takes in a given image, providing data such as the path taken, time until the first fixation, and total fixation time in a given area (Itti, 2004). The location that receives the most attention from the viewer will be the area with the most fixations and where the focus occurs for the longest time; thus, allowing us to assess which characteristic holds the greatest interest (Berlyne, 1958).

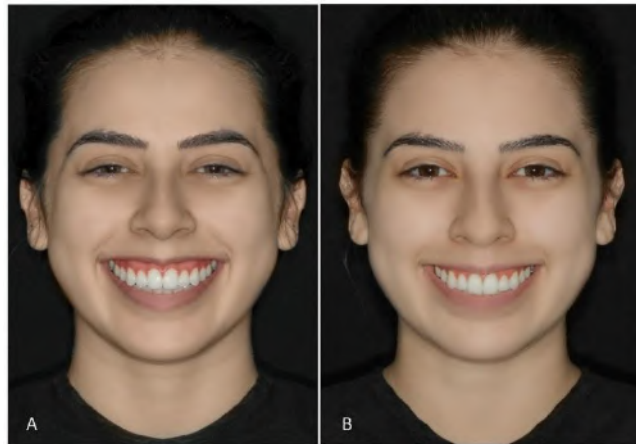
Exploring this methodology, not yet used for this purpose, this study aimed to evaluate the esthetic perception of a gingival smile before and after the application of botulinum toxin type A, using eye-tracking technology, a visual analog scale, and a questionnaire.

2. Methods

This observational cross-sectional prospective study was approved by the Research Ethics Committee of the University. The 58 participants were recruited via advertisement at the university. The inclusion criteria were: (1) aged between 18 and 75 years regardless of gender, (2) with no visual impairment or psychologic problems, and (3) lay in dentistry. All participants signed an informed consent form after learning the details and conditions of the study but were blinded to the study's purpose.

The images viewed by the participants were created through two facial photographs of a female volunteer model, 24 years old, with a gingival smile, one before and another 30 days after the botulinum toxin type A application (Figure 1). The site of injection of the toxin was at the Yonsei point, (Hwang et al., 2009) which consists of delimitation of an area of 2 cm in diameter, with the center established in the region of the elevator muscle of the upper lip, where the zygomatic minor muscle, the elevator muscle of the upper lip, and the wing of the nose meet. The toxin brand used was BOTOX® (Allergan, Inc., Irvine, California), in the form of an ampoule containing lyophilized powder. The content was diluted in 1 mL of 0.9% sodium chloride, totaling 100 units of toxin (10 units/0.1 mL). Two points were delimited on each side of the voluntary model's face for the application of two units of toxin in each of the four points.

Figure 1. Photographs taken before (A) and 30 days after (B) application of botulinum toxin type A.

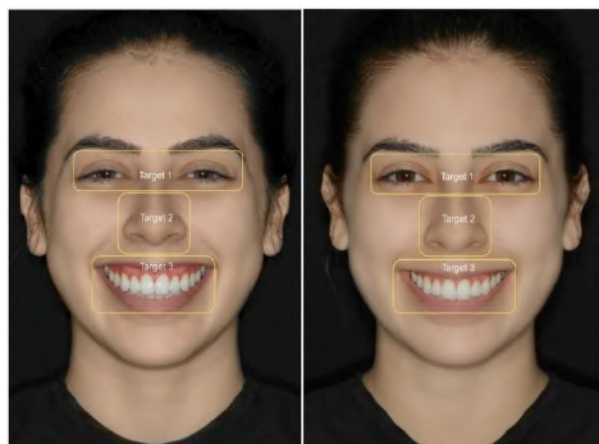


Source: Authors.

Photographs were taken with a Canon XT digital camera (Canon Inc., Tokyo, Japan), 50 mm Sigma macro lens, and a Sigma flash (Sigma Corp., Kawasaki, Japan) at a standard distance of 90 cm, with high-resolution quality, in an illuminated studio and with a black background. Her head was oriented with the Frankfurt plane parallel to the ground and with the median sagittal plane perpendicular to the horizontal plane, smiling, with limited makeup, without earrings and piercings. The photographs were standardized using Photoshop® (Adobe®, San Jose, CA, USA), removing imperfections that could distract the viewer's attention and focus from the objective (such as props and skin blemishes). Additionally, one side was mirrored so that the face was symmetrical.

For the analysis of eye movements, three areas of interest (AOIs) were determined in the images to be viewed (the participants were unaware of these delimitations at the time when the information was collected), to define regions on the face, such as the mouth, nose, and eyes (Figure 2).

Figure 2. Delimitation of Areas of Interest (AOI).



Source: Authors.

To start the eye-tracking test, the participants were invited to sit on a chair in a quiet room, 60 cm away from the high resolution (768 × 1366 pixels) monitor (Dell P2317H; Dell Inc., Round Rock, TX, USA) positioned vertically and from the

hardware eye-tracker. The calibration of the eye movement was performed, and only participants with software-designated admissible results were considered.

The hardware used for eye-tracking was TheEyeTribe® (The Eye Tribe Aps, Copenhagen, Denmark), in conjunction with OGAMA 5.0 software (Freie Universität, Berlin, Germany) to obtain the eye-tracking data collection. Based on the results, the number of fixations, the time until the first fixation, and the total fixation time on each AOI were analyzed, and the heat maps and map of visualization points were generated through the software. In the heat map, the averages between the visualizations were compared, progressing from the cold color (green) to the warm colors (red). The more reddish the color, the more visualizations a given area received. In the map of the visualization point, a dot was inserted into the image each time a visualization was detected.

The observers visualized a random sequence of 21 images, including the two images of the current study's volunteer model. One before and the other after the toxin application. The 19 extra images that were visualized were not included in this study. These consisted of facial images of children, youth, adults, and the elderly, all smiling, both male and female. Additional images were used to avoid comparisons between the images taken before and after the toxin application due to the proximity of the display. Each image was displayed for 5 seconds. To avoid interference from the final connection point to the previous slide, the first connection point on the next slide was programmed to be ignored, at a time interval of 200 ms, in the OGAMA 5.0.

A Visual Analogue Scale was used to analyze the attractiveness of facial esthetics after the eye-tracking session. The scale was presented on the screen, where a score should be established with a gradation of 0 to 100. A value closer to 0 indicates that the evaluator considered the image to be less attractive, and closer to 100, more attractive (Howells & Shaw, 1985). The twenty-one images used previously were also used to assess the VAS.

In the last stage of the research, the observers complete a survey on a Dell Inspiron 7375 touch 2 - 1 computer, opened in the Qualtrics® application (Qualtrics Labs Inc., Provo, UT). They could choose to respond on their mobile device, with the premise that the responses would be sent in the presence of the person responsible for the research. The questionnaire contained the following questions: "Do you consider this person to be friendly?," "Do you think that person is satisfied with their smile?," "Do you consider this person dissatisfied with their dental exposure?," "Do you consider this person dissatisfied with their gum exposure?," and "Do you consider this person to be shy?." The questions appeared in this sequence on the computer screen, below the image of the voluntary model, for the images before and after the application of botulinum toxin separately. The answers were arranged in the form of YES, if the person agreed with the question, and NO if they disagreed.

Statistical analysis

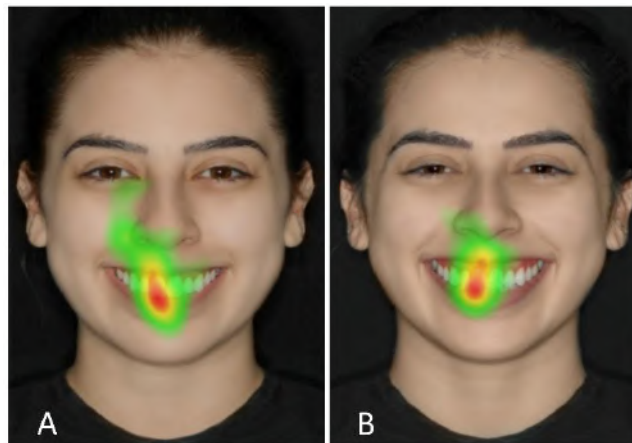
The results obtained from eye-tracking, VAS, and the questionnaire was tabulated in Microsoft Excel software and analyzed using SPSS version 25 (Statistical Package for Social Sciences Software, SPSS Inc., Chicago, IL, USA). The Student's t-test for independent samples was applied to analyze significant differences between the images concerning the number of fixations, time until the first fixation, total fixation time, VAS, and differences between male and female participants. The Kruskal-Wallis test was also applied between the variables of gaze tracking comparing the three AOIs. Pearson's Chi-square test was applied between the images in contrast to the variables sympathy, satisfaction with the smile, dissatisfaction with dental exposure, dissatisfaction with gingival exposure, and shyness.

3. Results

The study was conducted with 58 participants (60.3% men and 39.7% women). The average age was 35.81 years, with 37 years old being the average age for men and 34 years for women. Qualitative results were generated in the form of a heat map and dot map, and quantitative results were generated in the form of statistical analysis.

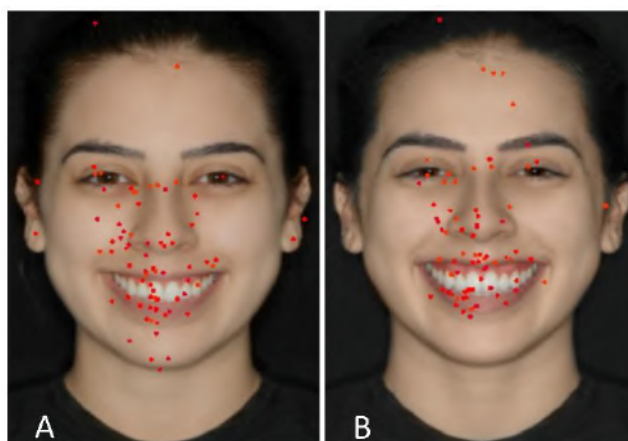
The results of the heat map before and after the toxin application are shown in Figure 3. For the pre-application image, the greatest focus was observed to be registered on the mouth, around the region of central incisors and gingival exposure, with little or no deviation to other areas. For the post-application image, the greater focus remained on the mouth, in the region of the incisors and lower lip. Furthermore, a greater deviation to the nose and ocular region was noticed, which was corroborated by the dot map analysis. (Figure 4).

Figure 3. Heat Map. Before (A); and 30 days after (B) application of botulinum toxin type A.



Source: Authors.

Figure 4. Map of visualization points. Before (A); and 30 days after (B) application of botulinum toxin type A.



Source: Authors.

There was no statistically significant difference in the AOIs before and after toxin application (Table 1). Concerning the AOI (eyes, mouth, and nose) (Table 2), it was noted that the region of the mouth took less time to attract attention ($p < 0.05$) when compared to the eyes and nose.

Table 1. Comparison between image before and after application of botulinum toxin type A x eye-tracking.

Variables	Group	Mean	Std Deviation	Std Error Mean	P valor
Number of fixations at eyes	With gingival smile	2.20	1.643	0.735	0.788
	Without gingival smile	2.00	0.632	0.258	
Number of fixations at nose	With gingival smile	1.33	0.707	0.236	0.844
	Without gingival smile	1.27	0.647	0.195	
Number of fixations at mouth	With gingival smile	2.54	1.532	0.313	0.196
	Without gingival smile	1.95	1.465	0.320	
Time until 1st fixation at eyes	With gingival smile	2671.00	1.549.041	692.752	0.268
	Without gingival smile	1816.33	809.242	330.371	
Time until 1st fixation at nose	With gingival smile	1763.67	1.700.588	566.863	0.626
	Without gingival smile	2134.45	1.629.582	491.337	
Time until 1st fixation at mouth	With gingival smile	779.92	1.324.472	270.357	0.646
	Without gingival smile	607.71	1.149.789	250.905	
Complete fixation time at eyes	With gingival smile	619.40	572.896	256.207	0.979
	Without gingival smile	626.50	262.515	107.171	
Complete fixation time at nose	With gingival smile	534.22	591.116	197.039	0.742
	Without gingival smile	460.36	392.490	118.340	
Complete fixation time at mouth	With gingival smile	1145.96	850.192	173.545	0.151
	Without gingival smile	807.29	679.529	148.285	

Source: Authors.

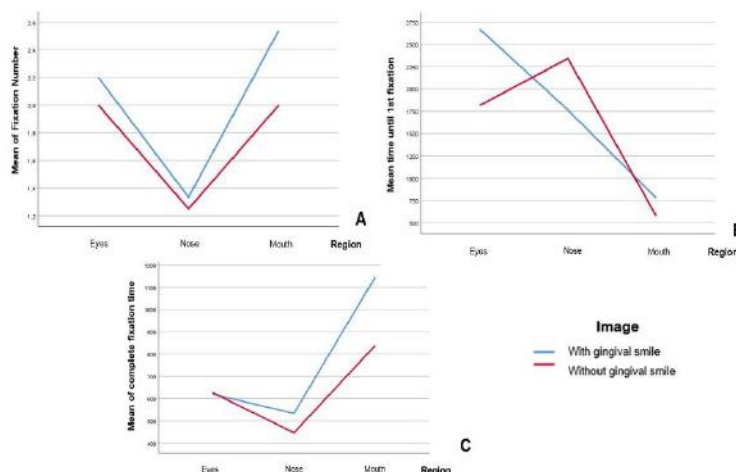
Table 2. Comparison between areas of interest before and after application of botulinum toxin type A

Eye-tracking	With gingival smile	Without gingival smile	P valor
	Mean (std deviation)	Mean (std deviation)	
Number of fixations at eyes	2.20 (.735)	2.00 (.258)	0.54
Number of fixations at nose	1.33 (.236)	1.25 (.179)	
Number of fixations at mouth	2.54 (.313)	2.00 (.309)	
Time until 1st fixation at eyes	2671.00 (.692.752)	1816.33 (330.371)	0.001*
Time until 1st fixation at nose	1763.67 (566.863)	2342.50 (494.429)	
Time until 1st fixation at mouth	779.92 (270.357)	580.09 (240.818)	
Complete fixation time at eyes	619.40 (256.207)	626.50 (107.171)	0.138
Complete fixation time at nose	534.22 (197.039)	447.00 (108.853)	
Complete fixation time at mouth	1145.96 (173.545)	838.73 (144.838)	

Source: Authors.

Figure 5 represents this statistical analysis, allowing verification of the difference between the time until the first fixation (Fig. 5B) before and after the application of the botulinum toxin.

Figure 5. AOI eye-tracking. Mean of fixation number (A), time until first fixation (B), and complete fixation time (C).



Source: Authors.

The VAS scores showed a statistically significant difference between the two research images ($p = 0.000$) (Table 3). The pre-treatment image received lower average scores than the post-treatment image, which was deemed more attractive than the image with gingival exposure.

Image	Group	Mean	Std Deviation	Std Error Mean	P valor
VAS	With gingival smile	48.76	23.380	3.070	0.000*
	Without gingival smile	68.57	27.404	3.598	

Source: Authors.

The five categories: “sympathy,” “satisfaction with the smile,” “dissatisfaction with dental exposure,” “dissatisfaction with gingival exposure,” and “shyness” correlated with the images (Table 4). The variables “satisfied with the smile” ($p = 0.000$), “dissatisfied with the exposure of the gums” ($p = 0.000$), and “dissatisfied with the exposure of the teeth” ($p < 0.05$) were statistically different. According to the observers, the model would be more dissatisfied with the excessive gum exposure before the application than after, and the latter would be satisfied with her smile and dissatisfied with her dental exposure.

A comparison of the questionnaire items between the sexes is shown in Table 5. There was a statistical difference between the sexes ($p < 0.05$) in the item “sympathy” of the questionnaire for the image after application of the botulinum toxin. For women, the person in the image with the least gingival exposure appeared to be more “sympathetic”. For men, this decreased after the application of botulinum toxin. In the image before the toxin application, the response rate was similar between men and women.

Questionnaire	Answer	With gingival smile	Without gingival smile	P valor
Sympathetic	Yes	48.50%	51.50%	0.852
	No	51.90%	48.10%	
Satisfied with smile	Yes	19.60%	80.40%	0.0000*
	No	68.90%	31.10%	
Dissatisfaction with dental exposure	Yes	23.10%	76.90%	0.039*
	No	53.30%	46.70%	
Dissatisfaction with gingival exposure	Yes	80.40%	19.60%	0.0000*
	No	31.10%	68.90%	
Shyness	Yes	33.30%	66.70%	0.402
	No	50.90%	49.10%	

Source: Authors.

There were no statistically significant differences in the other items of the questionnaire. Both men and women considered that there was an increase in satisfaction with the smile and a decrease in dissatisfaction with gingival exposure in the image after the toxin application.

Questionnaire		With gingival smile			Without gingival smile		
Variable	Answer	Male	Female	P valor	Male	Female	P valor
Sympathetic	Yes	54.3%	56.5%	0.867	45.7%	73.9%	0.034*
	No	45.7%	43.5%		54.3%	26.1%	
Satisfied with smile	Yes	17.1%	8.7%	0.361	54.3%	69.6%	0.245
	No	82.9%	91.3%		45.7%	30.4%	
Dissatisfaction with dental exposure	Yes	2.9%	8,70%	0.326	14.3%	21.7%	0.462
	No	97.1%	91,30%		85.7%	78.3%	
Dissatisfaction with gingival exposure	Yes	62.9%	65.2%	0.855	20.0%	8.7%	0.245
	No	37.1%	34.8%		80.0%	91.3%	
Shyness	Yes	0.00%	8.7%	0.076	11.4%	0.00%	0.093
	No	100.00%	91.3%		88.6%	100.00%	

Source: Authors.

Both men and women took less time for the first visualization in the mouth, compared with the eyes and nose; in both, the image before and after the toxin application (Table 6).

Table 6. Comparison of average values for variables of eye-tracking in relation to participant's sex

Eye-Tracking		With gingival smile		Without gingival smile	
Variable	Sex	Mean	P valor	Mean	P valor
Number of fixations at eyes	Male	2.0	0.913	1.67	0.230
	Female	2.25		2.33	
Number of fixations at nose	Male	1.17	0.535	1.0	0.215
	Female	1.67		1.75	
Number of fixations at mouth	Male	2.60	0.816	2.08	0.562
	Female	2.44		1.78	
Time until 1st fixation at eyes	Male	3130.00	0.790	1989.00	0.656
	Female	2556.25		1643.67	
Time until 1st fixation at nose	Male	1163.67	0.143	2973.43	0.003*
	Female	2963.67		666.25	
Time until 1st fixation at mouth	Male	741.53	0.859	852.08	0.241
	Female	843.89		281.89	
Complete fixation time at eyes	Male	499.00	0.851	542.67	0.497
	Female	649.50		710.33	
Complete fixation time at nose	Male	462.50	0.639	323.71	0.301
	Female	677.67		699.50	
Complete fixation time at mouth	Male	1254.07	0.433	768.75	0.912
	Female	965.78		858.67	
VAS	Male	47.22	0.637	66.34	0.437
	Female	50.26		71.96	

Source: Authors.

There was a statistically significant difference ($p < 0.05$) in the time until the first fixation on the nose, in the image without a gingival smile, where men took considerably longer to look at this region when compared to women. The total time of fixation on the mouth by male viewers was greater than in the AOIs "eye" and "nose." For women, there was a balance between the views of the three areas of interest. Both sexes exhibited increased VAS scores in the image with less gingival exposure, considering the image to be more attractive after the toxin application.

4. Discussion

This study aimed to evaluate the esthetic perception of the face following a reduction of excessive gingival exposure by application of botulinum toxin type A in a female volunteer, using eye-tracking technology, a visual analog scale, and a questionnaire. The intervention in this study sought to obtain an authentic result, which may not be credible with the use of digitally manipulated images. The alteration of normality in the visualizations in this study, with the mouth receiving more attention than the nose and mouth, was similar to other eye-tracking studies where the attention was highlighted (Richards et al., 2015)(Johnson et al., 2017) in the modified region, as opposed to the studies where the attention pattern is on the eyes in images considered normal (Mertens et al., 1993)(Hickman et al., 2010).

The gingival smile, considered an unattractive feature, (Celikdelen & Bicakci, 2020; Pithon et al., 2013) may have influenced this greater concentration of visualizations on the region of the mouth in the image displaying greater gingival exposure, before the toxin application, as verified by the heat and dot maps. Although there were differences in the eye region before and after the application of botulinum toxin in the present study, this did not affect the results since this region did not receive as much visualization as the AOIs.

The existence of cultural reading patterns, such as reading progressively from left to right or from right to left, may have influenced the concentration of visualizations on the left side in the heat maps and dot maps. The same result was observed in studies with Brazilians (Gobel, 2015) and Indians, (Bagepally, 2015) where the reading pattern occurred from left to right. In studies carried out in Asian countries, for example in China, where the reading pattern is from right to left, the result may be reversed, with the right side receiving more views. (X. Wang et al., 2016) For this reason, it is advisable to mirror one side of the image, as performed in the present study.

Regarding the benefit of botulinum toxin, the results suggest a statistically significant increase in facial attractiveness after the application of the toxin. These results are consistent with the esthetic improvement of the gingival smile after the toxin application in other studies, which also used the visual analog scale as an evaluation measure. In these surveys, the scales varied from 1 to 5 (Sriphadungporn & Chamnannidiadha, 2017), from 1 to 10 (Cengiz et al., 2020), and, as in the present study, from 1 to 100 (Cengiz et al., 2020; Sucupira & Abramovitz, 2012). It was found that, regardless of the gradation used in the VAS in these analyses, the average of the grades that the evaluators gave the images before the toxin were smaller, increasing in the images after the toxin application. The same result was obtained in this study, with an average visual analog scale score of 48.76 before and 69.57% after the toxin application, and an 42.67% increase in facial attractiveness.

In the present study, there was no statistically significant difference in perception between men and women when evaluating the face as a whole, both in the tracking of the visualization and in the evaluation of the VAS. The same result was found in other studies that used the same tools (Chang et al., 2011; Ker et al., 1999). Conversely, one study found that the female sex evaluates the gingival smile with higher marks than does the male sex (Geron & Atalia, 2005). Forty-six participants used only images of the lower third of the model, where a complete facial evaluation was not possible. By using the image of the entire face of the voluntary model, we allowed the gingival smile to be analyzed not as an isolated component, but in conjunction with other characteristics for a more complete assessment of its influence on facial attractiveness.

The results suggest that the possibility of correcting the gingival smile proposed in this study can be presented to patients as an alternative treatment since laypeople considered the face of the voluntary model more attractive after decreasing excessive gingival exposure. Although botulinum toxin has a short duration of action (from 12 to 24 weeks) (Chagas et al., 2018), this minimally invasive treatment (Polo, 2008) may be preferred by patients, especially considering its reversibility. This is because there is a physiological decrease in the exposure of the upper incisors and an increase in exposure of the lower incisors with aging, compared to other existing irreversible treatments, such as orthodontic treatment, orthognathic surgery, and lip repositioning (Abdullah et al., 2014). Therefore, it can be used as an adjunct treatment in orthodontics and periodontics. Also, the perception of esthetic attractiveness after improving teeth morphology was higher compared to before (Martins et al., 2021).

5. Conclusions

There was a variation in the perception of facial esthetics after the application of botulinum toxin. A decrease in gingival exposure resulted in improved attractiveness. There was also an increase in “satisfaction with the smile” and “dissatisfaction with dental exposure,” as well as a decrease in “dissatisfaction with gingival exposure.”

This study has clinical implications and is relevant because showed a treatment alternative for the patient with dental exposition. As a future perspective, it is suggested that should be carried in elder patients.

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