

# Perception on Oclusal Pigmentation of Pits and Fissures in Simulated Aesthetic Restoration

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## ABSTRACT

**Background:** There are several resources to mimic the restorations in dental structures. The biological sealing can be confused with a carious lesion when seen by a layman. The aim of this study was to analyze the perception of occlusal characterization in posterior aesthetic restorations, using different degrees of pit and fissure pigmentation simulating biological sealing. **Methods:** This work analyzed the perception of dental students and lay patients in the acceptance of simulated aesthetic restorations in posterior teeth with different degrees of occlusal pigmentation, simulating the biological sealing. It is a cross-sectional research involving dental students and lay patients of the Federal University of Ceara (UFC) and Federal University of Espírito Santo (UFES). **Results:** Participants answered a questionnaire where, through pictures, the interviewees indicated which occlusal characterization they considered more esthetic. Lay participants tended to prefer restorations without pigmentation of pits and fissures while students preferred mostly restorations that accompany the level of pigmentation of adjacent teeth. Regarding the difficulty among students

in visually differentiating biological sealing from a caries lesion, most of the UFC students (55%) stated that “yes”, while the majority of the UFES (52%) answered that “sometimes” ( $p=0.018$ ). **Conclusion:** It is known that pictures are not sufficient means for the detection of dental caries, but that can be useful to evaluate if the interviewee associates the image with the disease, even without the technical knowledge to do so.

**Key words:** Esthetics Dental, Dental coloring, Dental Restoration, Permanent, Diagnosis.

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DOI: 10.5530/jyp.2019.11.44

## INTRODUCTION

The concept of aesthetics, including dental, for the human being is extremely subjective and is related to beauty and harmony, being conditioned to several factors (Social, psychological, cultural, temporal and age) that vary from individual to individual.<sup>1,2</sup> Thus, specific considerations should be made when treating patients who present particular needs and characteristics and should be related to the tooth to be restored and to neighboring teeth.<sup>3</sup> However, the definition of what is aesthetically acceptable suffers also a great influence of the media today. White and aligned teeth are considered by the majority of the population as an ideal pattern of aesthetic beauty, although a large part is not aware of this television influence.<sup>4</sup> This pre-established pattern of beauty, coupled with the lack of anatomical and physiological knowledge, usually leads the patient to aim and require the professional restorations that do not always become harmonic and consistent with their natural teeth.

Tooth discoloration is common in the population and occurs due to genetic, environmental and dental factors, which may occur even before tooth eruption in the buccal environment. The most frequent causes are related to food, iatrogenic, tobacco and restoring materials. In addition, microtrauma in the teeth also favor the incorporation of exogenous pigments into the enamel.<sup>5</sup>

In spite of this, restorative dentistry has been seeking the development and improvement of new techniques and materials that allow the de-

tailed mimicking of structures and pigments present in natural teeth.<sup>6</sup> In addition, it has been developed restoring materials with characteristics of biocompatibility, durability and better aesthetic appearance.<sup>7</sup>

In natural posterior teeth, the presence of pigmentation of cicatrules and cracks is frequent and may occur due to the incorporation of exogenous and mineral pigments in inactive caries lesions during the remineralization process,<sup>8</sup> Forming the so-called “biological sealing”.<sup>9</sup> This condition is not pathological and in certain proportions, the use of dyes in cicatricles and cracks acts by altering the color homogeneity in direct restorations conferring an aspect of naturalness to the tooth.<sup>10</sup> When the neighboring teeth. Also present this biological sealing. However, there is a problem in the sense that biological sealing is visually mistaken by professionals and academics with a carious lesion, hindering the differential diagnosis.<sup>11,12</sup>

Regarding the differential diagnosis, the issue of the visual appearance of biological sealing in mimetic restorations is not so relevant, since in addition to clinical observation, other assessments, such as radiographic, can be made, confirming that this is a restoration.<sup>7,8</sup> However, under the vision of laypeople or patients, this is a very interesting aspect to be analyzed, because after direct or indirect posterior restorations are made, although the pigmentation of cicatricles and cracks is a characteristic inherent to their contiguous natural teeth.<sup>9,10</sup> Many patients do not accept it in their restorations, by visual comparison with the appearance of

a carious lesion. Thus, different aesthetic visions are perceived on the occlusal characterization for posterior restorations between professionals, academics and laypeople.<sup>11,12</sup>

In this context, the clinician should be aware of the different points of view linked to the aesthetic referential of each patient, so that during restorable procedures can seek the highest level of satisfaction possible, without giving up the characteristics Physiologically normal tooth. Thus, this study aimed to analyze the perception and satisfaction of occlusal characterization in posterior aesthetic restorations with different graduations of pigmentation of cicatrices and cracks.

## MATERIALS AND METHODS

This is a cross-sectional research, attended by students of Dentistry and lay patients from the Federal University of Ceara-Campus Sobral (UFC) and the Federal University of Espirito Santo (UFES). The research was approved by the Ethics in Research Committee of the Federal University of Espirito Santo (UFES) (CEP No. 202.727) according to resolution 466/2012 of the Brazilian National Health Council.

Individuals between 18 and 70 years of age, regardless of race, gender or schooling, were included as lay participants.

Considering 30 students per period, there was a population of 180 students. A sampling error of 7% was used and a confidence level of 90%. Due to the difficulty of establishing a fixed number of patients using the dental services of the UFES and the UFC, the sample of patients was established based on the sample obtained for the students.

After signing the Written Informed Consent Form (WICF), the research participants were submitted to a questionnaire with personal information for classification criteria and questions related to oral health for the criterion of analysis of obtained data. Finally, they answered to personal opinion questions regarding the acceptance of occlusal aesthetic restorations with different levels of occlusal characterization (Pigmentation). For this purpose, the participation of a collaborator was requested, with healthy hemi-arcade, caries-free, biological sealing or restorations. This collaborator was submitted to prophylaxis with prophylactic paste and Robinson brush, as well as to the complete clinical oral examination to ascertain any pathological conditions, so that, in case of necessity, he was duly referred for treatment. Then, the picture of a hemi-arcade of the collaborator was performed to be used in the questionnaire survey. From this initial picture the images were digitally treated simulating a dental condition with the characteristic of biological sealing (pigmentation of cicatrices and cracks) mild. Thus, three situations were suggested.

In a first situation (Figure 1), the teeth 44, 45 and 47 were gently pigmented and the supposed restoration in the 46 tooth was not pigmented. In a second situation (Figure 2), the supposed restoration of tooth, 46 received the same level of pigmentation of adjacent teeth (44, 45 and 47). Finally, in a third situation (Figure 3), the supposed restoration of the 46 tooth was presented with greater pigmentation than that of the adjacent teeth (44, 45 and 47). These 3 photographic images have been modified through an image manipulation program (Adobe Photoshop CS6). After that, each interviewee visualized the three pictures, printed on photographic paper, simulating the aforementioned conditions. Then, the interviewed individuals answered questions related to oral and dental aesthetics.

The data were exported from Microsoft Excel to the Statistical package for the Social Sciences software, in which the analyses were performed with a confidence of 95%. The absolute and percentage frequencies of all cross variables were expressed by means of the Chi-square or Fisher's Exact tests.

## RESULTS

The sample of undergraduate students in Dentistry was composed mainly by undergraduate of the 4th semester (28.0%). In relation to the semester, the sample of 1st period students was significantly higher in the

UFC (Sobral). There was also significance in relation to the 6<sup>th</sup> period, where there was a predominance of Sobral students (14.0%) in relation to Vitoria (2.0%) ( $p=0,032$ ) (Table 1).

The profile of the participants did not indicate a statistical predominance in relation to gender. Considering the schooling of the lay participants, in the UFES (Vitoria) there were significantly more participants with incomplete elementary education (14%) and complete high school (42%) than in the UFC (Sobral). In contrast, in the UFC (Sobral) there were significantly more participants with complete higher education (32.0%), incomplete upper (24.0%) and with postgraduate (9.0%) ( $p=0.002$ ) (Table 2).

Regarding the brushing habits, there was no statistical predominance between the responses of both groups, where the majority stated brushing their teeth at least 3 times a day. It was observed that the lay participants of Sobral sought dental care especially in cases of pain or less than once a year in general, while those of Vitoria showed a frequency of dental appointment of at least once a year ( $p<0.001$ ). Considering undergraduate students, the frequency of dental appointments at once a year was higher among the students of Vitoria, while the frequency of 2 times a year or more occurred more frequently among the students of Sobral ( $p=0.038$ ). Questions related to the perception and concern regarding the general and dental aesthetics did not show statistical differences between the groups studied, where most of the participants, laypeople and students, demonstrated to have vanity, with care regarding their appearance in general, keeping within current aesthetic standards and worrying about dental aesthetics (Table 3).

The knowledge about the biological sealing occurred more in the group of undergraduate students, being unknown by almost all of the lay participants. The students of Vitoria presented significantly more knowledge about what is biological sealing than the students of Sobral ( $p<0.001$ ) (Table 3).

**Table 1: Distribution of Students from Both Universities According to the College Period.**

	Dentistry students			
	Total	UFC (Sobral)	UFES (Vitoria)	p-Value
Semester				
1	19	15*	4	0.032
	12.7%	15.0%	8.0%	
3	33	20	13	
	22.0%	20.0%	26.0%	
4	42	25	17*	
	28.0%	25.0%	34.0%	
6	15	14*	1	
	10.0%	14.0%	2.0%	
7	2	1	1	
	1.3%	1.0%	2.0%	
8	31	17	14	
	20.7%	17.0%	28.0%	
10	8	8	0	
	5.3%	8.0%	0%	

Data expressed in the form of absolute and percentage frequencies.

\* $p<0.05$ , Chi-square or Fisher's Exact test.

**Table 2: Participants' Profile.**

	Lay participants				Student participants			
	Total	Sobral	Vitoria	p-Value	Total	UFC (Sobral)	UFES (Vitoria)	p-Value
Genre								
Female	87	55	32	0.292	105	70	35	1.000
	58.0%	55.0%	64.0%		70.0%	70.0%	70.0%	
Male	63	45	18		45	30	15	
	42.0%	45.0%	36.0%		30.0%	30.0%	30.0%	
Schooling								
Illiterate	3	2	1	<b>0.002</b>	0	0	0	0.152
	2.0%	2.0%	2.0%		0%	0%	0%	
Incomplete ES	11	4	7*		0	0	0	
	7.3%	4.0%	14.0%		0%	0%	0%	
Complete ES	6	3	3		0	0	0	
	4.0%	3.0%	6.0%		0%	0%	0%	
Incomplete HS	10	9	1		0	0	0	
	6.7%	9.0%	2.0%		0%	0%	0%	
Complete HS	38	17	21*		0	0	0	
	25.3%	17.0%	42.0%		0%	0%	0%	
Incomplete HE	42	32*	10		146	96	50	
	28.0%	32.0%	20.0%		97.3%	96.0%	100.0%	
Complete HE	30	24*	6		4	4	0	
	20.0%	24.0%	12.0%		2.7%	4.0%	0%	
Postgraduate	10	9*	1		0	0	0	
	6.7%	9.0%	2.0%		0%	0%	0%	

Data expressed in the form of absolute and percentage frequencies.

\* $p < 0.05$ , Chi-square or Fisher's Exact test.

Table 4 presents the results of the participants' opinion regarding the appearance of the restorations. When questioned about which restoration approached more than one natural tooth, the lay participants pointed more at picture 1 and the students pointed more at picture 2. There was no statistical difference between the answers of the laity, within the responses for each picture, when compared Sobral to Vitoria ( $p=0,058$ ). Comparing students' responses among cities, picture 1 was significantly more chosen by Sobral students while picture 2 was significantly more chosen by Vitoria students ( $p= 0.014$ ) (Table 4).

Questioned about which restoration they would choose if they had mild pigmentation in their teeth, the lay participants of both cities chose mainly picture 1 to the detriment of the others. Among the student's participants there was statistical difference ( $p < 0.001$ ) for the choice of picture 1 in Sobral (54.0%) and for picture 2 in Vitoria (72.0%) (Table 4). Considering the restorations of the 46 teeth, in general, lay participants considered picture 1 as the most beautiful. When the students were questioned, there was a predominance in the choice of picture 1 for the students of Sobral (76.0%) while the ones from Vitoria chose more picture 2 (64.0%) ( $p < 0.001$ ). Overall, considering laypeople and students from both cities, the majority of the participants classified the restoration of Figure 3 as the least beautiful and presented a greater similarity with a decayed tooth (Table 4).

Regarding the difficulty in visually differentiating biological sealing of a caries lesion 47.3% of the participants answered that they had diffi-

culty. There was a significant difference between the cities, where most of Sobral's students claimed to have difficulty (55.0%), while the ones in Vitoria responded to having difficulties "sometimes" (52.0%) ( $p=0.018$ ) (Table 4).

## DISCUSSION

The correct detection and diagnosis of a caries lesion is essential in the decision of the professional about which intervention to choose,<sup>13</sup> since the incorrect detection of carious lesion in a pigmented sulcus would lead to the removal of healthy dental tissue, Which goes against the modern concepts of minimally invasive Dentistry.<sup>14</sup>

Tuñas *et al.*<sup>15</sup> emphasize that darkened grooves, which are the result of biological sealing, still need attention nowadays, because in the past these grooves were often considered caries lesions that required restoring treatment. Even today, many patients have doubts about this and therefore need to be clarified that this is not a pathological condition.

The fact that 98.0% of the laity interviewed reported not knowing the term biological sealing (Table 3) confirms that this group has no technical knowledge to differentiate a sharper pigmentation of a fissure as a natural characteristic of a healthy tooth. Thus, some lay people could judge a healthy tooth as a carious. This can be directly linked to the aesthetic perception of this population, which is highly subjective.<sup>1,2</sup> To the professional, it is worth understanding this aesthetic perception as extremely important, because it can affect the planning of aesthetic

**Table 3: Hygiene Habits and Perception of Dental Health and Aesthetics.**

	Lay participants				Student participants			
	Total	Sobral	Vitoria	p-Value	Total	Sobral	Vitoria	p-Value
<b>Brushing frequency</b>								
Up to 1 time a day	6 4.0%	4 4.0%	2 4.0%	0.915	1 7%	1 1.0%	0 0%	0.335
2 times a day	33 22.0%	23 23.0%	10 20.0%		8 5.3%	7 7.0%	1 2.0%	
3 times a day	111 74.0%	73 73.0%	38 76.0%		141 94.0%	92 92.0%	49 98.0%	
<b>Frequency of Dental Appointment</b>								
When feels pain	28 18.7%	22* 22.0%	6 12.0%	<0.001	8 5.3%	8 8.0%	0 0%	0.038
Less than once a year	59 39.3%	48* 48.0%	11 22.0%		8 5.3%	4 4.0%	4 8.0%	
Once a year	34 22.7%	19 19.0%	15* 30.0%		50 33.3%	28 28.0%	22* 44.0%	
2 times a year or more	29 19.3%	11 11.0%	18* 36.0%		84 56.0%	60* 60.0%	24 48.0%	
<b>Do you consider yourself a vain person and take care of your overall appearance?</b>								
No	34 22.7%	18 18.0%	16 32.0%	0.054	10 6.7%	8 8.0%	2 4.0%	0.355
Yes	116 77.3%	82 82.0%	34 68.0%		140 93.3%	92 92.0%	48 96.0%	
<b>Do you seek to stay within the current aesthetic standards?</b>								
No	41 27.3%	24 24.0%	17 34.0%	0.195	26 17.3%	19 19.0%	7 14.0%	0.446
Yes	109 72.7%	76 76.0%	33 66.0%		124 82.7%	81 81.0%	43 86.0%	
<b>Do you care about your dental aesthetics?</b>								
No	3 2.0%	2 2.0%	1 2.0%	1.000	3 2.0%	3 3.0%	0 0%	0.551
Yes	147 98.0%	98 98.0%	49 98.0%		147 98.0%	97 97.0%	50 100.0%	
<b>Do you know what biological sealing is?</b>								
No	147 98.0%	97 97.0%	50 100.0%	0.216	56 37.3%	48* 48.0%	8 16.0%	<0.001
Yes	3 2.0%	3 3.0%	0 0%		94 62.7%	52 52.0%	42* 84.0%	

Data expressed in the form of absolute and percentage frequencies.

\*p<0.05, Chi-square or Fisher's Exact test.

**Table 4: Perception of Students and Laypeople Regarding Selected Pictures.**

	Laity				Student			
	Total	Sobral	Vitoria	p-Value	Total	Sobral	Vitoria	p-Value
<b>Which one, in your opinion, is closest to a natural tooth?</b>								
Picture 1	83	51	32	0.058	33	29*	4	<b>0.014</b>
	55.3%	51.0%	64.0%		22.0%	29.0%	8.0%	
Picture 2	49	39	10		104	63	41*	
	32.7%	39.0%	20.0%		69.3%	63.0%	82.0%	
Picture 3	18	10	8		13	8	5	
	12.0%	10.0%	16.0%		8.7%	8.0%	10.0%	
<b>If your teeth had a mild pigmentation (such as the teeth 44, 45 and 47) which of the three restorations (in the tooth 46) would you prefer it to be placed in your mouth if you needed it?</b>								
Picture 1	105	68	37	0.751	64	54*	10	<b>&lt;0.001</b>
	70.0%	68.0%	74.0%		42.7%	54.0%	20.0%	
Picture 2	38	27	11		78	42	36*	
	25.3%	27.0%	22.0%		52.0%	42.0%	72.0%	
Picture 3	7	5	2		8	4	4	
	4.7%	5.0%	4.0%		5.3%	4.0%	8.0%	
<b>In your opinion, which of the three restorations (in the 46 tooth) is the most beautiful?</b>								
Picture 1	118	76	42	0.530	94	76*	18	<b>&lt;0.001</b>
	78.7%	76.0%	84.0%		62.7%	76.0%	36.0%	
Picture 2	28	21	7		53	21	32*	
	18.7%	21.0%	14.0%		35.3%	21.0%	64.0%	
Picture 3	4	3	1		3	3	0	
	2.7%	3.0%	2.0%		2.0%	3.0%	0%	
<b>In your opinion, which of the three restorations (in the 46 tooth) is the least beautiful?</b>								
Picture 1	19	12	7	0.886	25	13	12	0.206
	12.7%	12.0%	14.0%		16.7%	13.0%	24.0%	
Picture 2	5	3	2		5	4	1	
	3.3%	3.0%	4.0%		3.3%	4.0%	2.0%	
Picture 3	126	85	41		120	83	37	
	84.0%	85.0%	82.0%		80.0%	83.0%	74.0%	
<b>Do you think that some restoration (in the 46 tooth) shown in the photographs looks like a decayed tooth? If so, indicate which one.</b>								
Picture 1	5	4	1	0.724	3	2	1	0.248
	3.3%	4.0%	2.0%		2.0%	2.0%	2.0%	
Picture 2	1	1	0		0	0	0	
	7%	1.0%	0%		0%	0%	0%	
Picture 3	92	59	33		89	64	25	
	61,3%	59,0%	66.0%		59.3%	64.0%	50.0%	
None of them	52	36	16		58	34	24	
	34.7%	36.0%	32.0%		38.7%	34.0%	48.0%	
<b>Do you have difficulties to differentiate biological sealing from a caries lesion?</b>								
No	-	-	-	-	23	15	8	<b>0.018</b>
	-	-	-		15.3%	15.0%	16.0%	
Yes	-	-	-		71	55*	16	
	-	-	-		47.3%	55.0%	32.0%	
Sometimes	-	-	-		56	30	26*	
	-	-	-		37.3%	30.0%	52.0%	

Data expressed in the form of absolute and percentage frequencies.

\*p<0.05, Chi-square or Fisher's Exact test.



**Figure 1:** Simulation of the Restoration of the teeth 46 without Pigmentation of Cicatrics and Cracks.



**Figure 2:** Simulation of the Restoration of the Teeth 46 with Pigmentation of Cicatrics and Cracks Similar to Adjacent Teeth.



**Figure 3:** Simulation of the Restoration OF THE Teeth 46 with Pigmentation of Cicatrics and Cracks Sharper than the Adjacent Teeth.

restorer treatment, since 77.3% of the laity interviewed are considered vain, 72.7% care about the standards of current aesthetics and 98.0% care about dental aesthetics (Table 3). White teeth have been positively related to high levels of social competence, intellectual ability, psychological adjustment and relationship status.<sup>16</sup>

It was observed that the lay population, in general, had a choice predominantly by the restoration of Figure 1, where there is no pigmentation of cracks, although the neighboring teeth were slightly pigmented (Table 4). In other words, the laity do not care about the mimicking of

the restoration with the other teeth in the arch but prefer the lighter or “white” teeth.

One of the objectives of restorative dentistry is to allow the dentist to perform oral rehabilitation with functional and aesthetic restorations. Thus, the search for professionals and patients for aesthetically imperceptible restorations came to be supplied by the dental industry, which currently offers several possibilities of composites and pigments.<sup>17</sup>

Garcia *et al.*<sup>18</sup> emphasize that the aesthetic success of a restoration depends, among other factors, on the final combination of colors in relation to the adjacent natural dentition. However, even when the question of the questionnaire takes into account the adjacent teeth, pigmented and questions which restoration would be chosen in that context, the lay population predominantly chose the restoration without occlusal pigmentation (Table 4), reinforcing the search for white teeth as the ideal standard of current beauty.<sup>4</sup> The laity judged Figure 1 as being the most beautiful (78.7%) and the most natural (55.3%) (Table 4). This result shows that the laity seem to have an aesthetic view limited to each tooth in isolation.

In the group of academics, there were significant differences for the answers between the two cities (Table 4). Overall, 69.3% of the participants considered the restoration of Figure 2 as the one that approximates most of a natural tooth. However, Figure 1 was significantly more pointed out by the students of Sobral than the students of Vitoria ( $p=0.014$ ). When questioned about which restoration would prefer to be made in their own mouth, if they had pigmented teeth, 54.0% of the participants of Sobral chose the restoration of photograph 1, while 72.0% of the participants of victory Preferred a restoration that mimicking the pigmentation of neighboring teeth. Also, the students of Sobral pointed out the restoration of Figure 1 as the most beautiful more often than the students of victory who indicated more the restoration of photography 2 ( $p<0.001$ ).

These data indicate divergence of dental aesthetic perception among students, since the students of Vitoria demonstrated to have a perception of dental aesthetics in conjunction with the oral aesthetics, where all teeth should show harmonics among themselves. This aesthetic perception occurred differently when comparing the students of Sobral, who demonstrated to prefer the tooth 46 with a clearer restoration, even when the adjacent teeth presented pigmentation (Table 4). It can be assumed that the fact that the students of Sobral presented less knowledge about biological sealing (Table 2) and greater difficulty in differentiating biological sealing of caries lesion (Table 4) may have influenced their aesthetic perception.

Composite resins are restorable materials with the greatest ability to reproduce the natural aesthetic characteristics of dental tissues. However, in the oral environment, resin restorations are susceptible to chemical and mechanical challenges being susceptible to pigmentation and staining. This pigmentation is related to intrinsic factors related to the restorer material itself and extrinsic, related to the habits and diet of the individual.<sup>19</sup>

The opinion of professionals regarding aesthetics may not coincide with the perceptions and expectations of patients and laypeople. Musskopf *et al.*<sup>20</sup> when assessing the aesthetic perception of the smile, also found differences between the perception of dentists and patients (Laity).

The results of the present study were similar to another study, which investigated the satisfaction with tooth staining and the general dental appearance of lay people and found no statistically significant differences between groups with different levels of schooling.<sup>16</sup>

Finally, it should be considered that patients are less critical about dental aesthetics than professionals and tend to accept better occlusal esthetic restorations without fossae and fissures pigmentation, when comparing with those pigmented, mimicking neighboring teeth. Therefore, since

patients are the most important individuals to be considered in restorable procedures, caution should be exercised when indicating something that will not be perceived as necessary by them or that can still lead to aesthetic dissatisfaction.<sup>20</sup> Thus, it can be inferred that the particularity of each patient should always be respected, considering his aesthetic opinion about his dentition before initiating the restorer procedure so that the restorer treatment can reach the maximum patient satisfaction and not necessarily of the dentist surgeon.

## CONCLUSION

It is known that photographs are not sufficient means for the detection of dental caries, but which may be useful to assess whether an individual associate that image with the disease, even without technical knowledge. In the present study there was a tendency of the lay participants to prefer restorations without pigmentation of cracks and cicatrices while, among the academics, there was divergence when comparing the two cities. The students of Sobral presented a greater tendency to choose clearer restorations without pigmentation and those of Vitoria were biased, mostly, to prefer restorations accompanying the level of pigmentation of adjacent teeth.

## ACKNOWLEDGEMENT

We Acknowledge the Federal University of Ceara and Federal University of Espirito Santo for support this study and all the participants.

## CONFLICT OF INTEREST

The author declare that there is no conflict of interest.

## ABBREVIATIONS

UFC: Federal University of Ceara; UFES: Federal University of Espirito Santo; WICF: Written Informed Consent Form.

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**Article History:** Submission Date : 12-01-2019; Revised Date : 02-02-2019; Acceptance Date : 01-03-2019.

**Cite this article:** Selvatici RS, Valadas LAR, Lotif MAL, Tapety CMC, Pazinato FB. Perception on Oclusal Pigmentation of Pits and Fissures in Simulated Aesthetic Restoration. J Young Pharm. 2019;11(2):213-9.