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Research Article

Effect of Different Chlorhexidine Mouth-Rinses Concentrations and Different Light Cure Intensities on Composite Filling Discoloration (*In Vitro* Study)

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Abstract

Background: The aim of our study is to estimate the effects of three commercially available mouth-rinses with three different concentrations (0.2%, 0.12%, 0.02%) with three different intensities light cures which are (100, 300, 600 nm) to assess correlation between the effects of different CHX. Concentration and different intensities of light cure on composite discoloration.

Materials and Methods: 48 copper band samples had been prepared and filled with composite. 3 CHX Mouth-rinses with different concentrations (0.2%, 0.12%, 0.02%) but the same color (green), with three different intensities of light cure (100, 300, 600 nm) were applied. Sixteen samples were light cured by (100 nm) light intensity, five samples were immersed into a black tube which contained CHX. Conc. 0.2%, other 5 specimens in CHX. Conc. (0.12%), and other 5 specimens in CHX. Conc. (0.2%), except the last one had been immersed into a distilled water to be used as a standard color for comparison with other test tubes to know how much it was discolored, the same procedure was repeated for (300, 600 nm) light intensities, these tastes were visually evaluated under natural light each 24 hours, because of difficulties of acquiring spectrophotometer which specify composite resin.

Results: Highest light cure intensity used produced lesser change in color, by decreasing CHX. Conc. (0.02%) less color change occurred.

Conclusion: The effect of discoloration is greater with high CHX. Conc. (0.2%) and low light intensity (100 nm). Less color change achieved with high intensity light cure (600 nm) because it could produce greater polymerization of composite resin, also less color change achieved with low CHX. Conc. (0.02%).

Keywords: CHX; Mouth-Rinse; Composite Resin; Light Cure

Introduction

Dental resin composites are plastic, remedial materials that compromises of co-polymerized methacrylate based resin installing rigid filler particles (presenting quality and wear obstruction) and need a different glue (bonding agent) to small scale nano precisely bond them to either dentin or enamel [1].

One of the most widely recognized purposes behind substitution of composite rebuilding efforts is that style is impacted by stains of resin-based materials [2].

In this manner, the shading consistency of composite rebuilding efforts is a need and the shading is relied upon to stay constant during the practical lifetime. Both external and substantial factors bring out staining of resin composites [3]. Outer stains outcome from adsorption and inhibition-dissolve material during the resin molding. Definite dietary propensities, for example drinking Cola, tea and mouth rinses like chlorhexidine, those types include alcohol in their structure or tobacco biting could recolor composites to different degrees [4].

Substantial components include the staining of the resin material oneself, for example modification of the resin mold, and changes in the interface of the fillers and mold [5]. Chlorhexidine is a bisbiguanide rule, cationic detergent with a wide range of anti-bacterial action (versus Gram-positive and Gram-negative microbes and definite mycetes). Thus, it has been broadly concentrated in clinical precision as a disinfectant aggravate that is the reason more often that not recommended if there should arise on occurrence of gum disease [6].

Effective polymerization of composite resins is fundamental to the clinical prosperity of the restoration and its staining [7]. The fitness is influenced by many reasons such as the light intensity [8], period of insinuation time [9], space of light cure and measurement of the light evidence in the light curing device [10].

Materials and Methods

In our *in-vitro* experimental study, 48 disc shaped samples 2 mm thickness prepared by cutting them by CNC (computer numeral control) in a copper band mound with a celluloid matrix and 1 kg weight to get perfect adaptation of composite by exerting pressure on it to have a uniform thickness. Composite resin was polymerized with LED unit at 3 intensities (100, 300, 600 nm) for 20 seconds for 2 cycles from the upper surface of the specimen at close contact with the celluloid matrix. After that 9 black tubes were prepared to put samples inside them to avoid the effect of an ambient light. After that 16 samples were light cured by (100 nm) light intensity, 5 samples were immersed into a black tube which contained CHX. Conc. (0.2%), 5 samples in CHX. Conc. (0.12%), and other 5 specimen in CHX. Conc. (0.2%), except the last one was immersed into distilled water as a control to allow comparison with other samples to know how much it got discolored, the same procedure was repeated for (300, 600nm) light intensities (Figure 1-9).

Figure 1: Black tubes that were used to immerse the samples in CHX.

Figure 2: (Premium plus), photometer that has been used for measuring light cure intensity.

Figure 3: Light cure intensity (100 nm).

Figure 4: Light cure intensity (300 nm).

Figure 5: Light cure intensity (600nm).

Figure 6: Severe discoloration of composite.

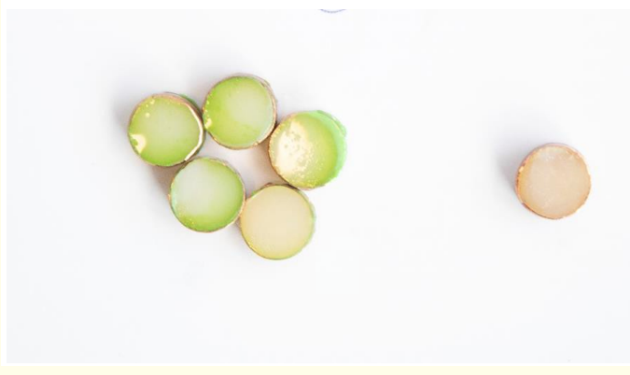

Figure 7: Moderate Discoloration of composite.

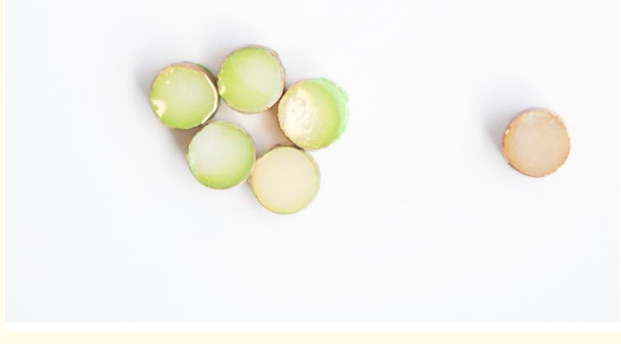

Figure 8: Mild discoloration of composite.

Figure 9: No color change of composite.

The lower surface of all samples had been checked visually by 3 examiners to scrutinize the effect of light intensity LED device, degree of polymerization of composite and the effect of different CHX, concentrations. The tests were visually evaluated under natural light every 24 hours by 3 examiners for 10 days (inter-examiner variability) because the ability of human eyes to appreciate differences in color differs from one individual to another (Figure 10), as it is a combination of eye characteristics and the skill of the operator [11].

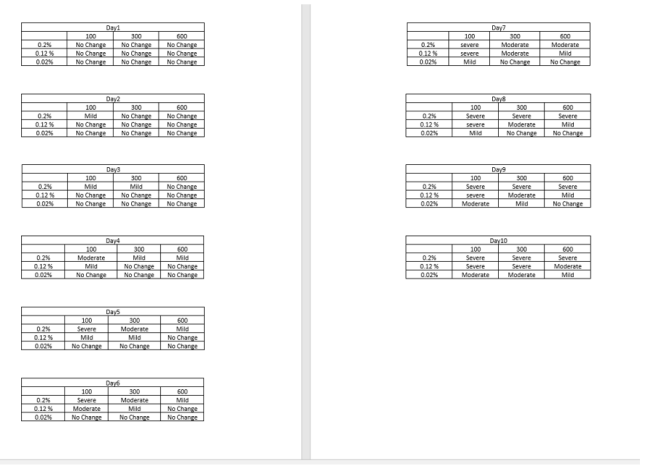

Figure 10: List of data which has been evaluated by 3 examiners.

There was a difficulty in acquiring spectrophotometer which is a more accurate method to detect color changes of dental restorations which is based on human perception and decrease subjective interpretation as compared with the virtual method [12-14]. The test samples were kept at a room temperature (26 - 28 Celsius).

Data management and statistical analysis

Data will be collected and entered in the computer and analyzed using appropriate data system which is called statistical package for social science (SPSS) version 25, the results will be compared between different variables in tables, figures, using Pearson chi square test with a statistical significant level at P 0.001, 0.002.

Results

Light cure intensity 100 nm

Table 1 and figure 11 showed a correlation (association) between light intensity and 100 nm, CHX 0.2% and color change, there was significant association or correlation between the application of light intensity 100 nm, CHX 0.2% and color change of composite resin over the period of the study. On the first day there was no change in color, after 2 - 3 days there was a mild change, which became moderate on the fourth day then severe for the rest of 10 days. Chi-square test was done and p-value was highly significant (0.001), this is most probably due to low intensity of light cure and high conc. of CHX 0.2%.

Days	Light intensity 100, chlorhexidine 0.2%				Total
	No change	Mild	Moderate	Severe	
One	3 (100%)	0 (0%)	0 (0%)	0 (0%)	3 (100%)
Two	0 (0%)	3 (100%)	0 (0%)	0 (0%)	3 (100%)
Three	0 (0%)	3 (100%)	0 (0%)	0 (0%)	3 (100%)
Four	0 (0%)	0 (0%)	3 (100%)	0 (0%)	3 (100%)
Five	0 (0%)	0 (0%)	0 (0%)	3 (100%)	3 (100%)
Six	0 (0%)	0 (0%)	0 (0%)	3 (100%)	3 (100%)
Seven	0 (0%)	0 (0%)	0 (0%)	3 (100%)	3 (100%)
Eight	0 (0%)	0 (0%)	0 (0%)	3 (100%)	3 (100%)
Nine	0 (0%)	0 (0%)	0 (0%)	3 (100%)	3 (100%)
Ten	0 (0%)	0 (0%)	0 (0%)	3 (100%)	3 (100%)
Total	3 (10%)	6 (20%)	3 (10%)	18 (60%)	30(100%)

Table 1: Highly significant association (correlation) between light intensity 100nm, chlorhexidine 0.2% and color change of the filling material over a period of ten days using Pearson chi-square and P value 0.001.

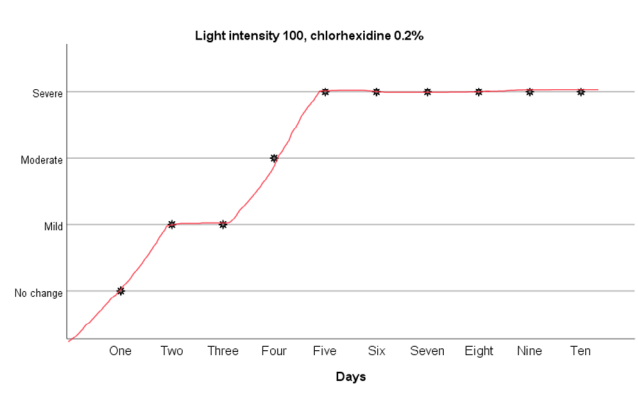

Figure 11: Association (correlation) between light intensity 100nm, chlorhexidine 0.2% and color change of the filling material over a period of ten days, P value 0.001 highly significant.

Table 2 and figure 12 showed correlation between light intensity 100 nm, CHX 0.12% and color change, there was a significant statistical association between light intensity 100 nm, CHX 0.12% and color change over the ten days. There was no change in color for the first 3 days then a mild change in color happened during the 4th or 5th days, the change became moderate on the 6th day and finally severely changed on the 7th day onward, Pearson chi-square test was done and P-value was 0.001, in this test color change was less common than 0.2% due to lower conc. of CHX.

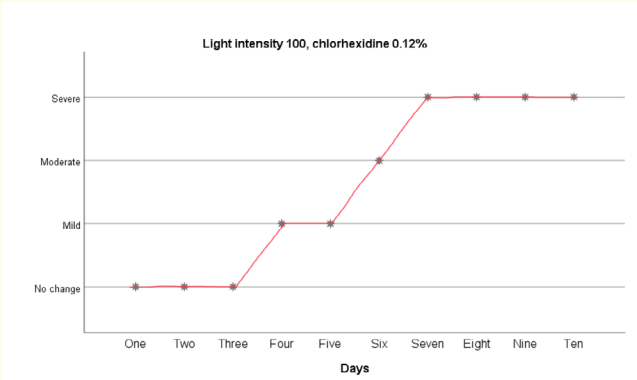

Figure 12: Correlation between light intensity 100 nm, chlorhexidine 0.12% and color change over ten days duration.

Light intensity 100, chlorhexidine 0.12%

Days		No change	Mild	Moderate	Severe	Total
One		3	0	0	0	3
		100.0%	0.0%	0.0%	0.0%	100.0%
Two		3	0	0	0	3
		100.0%	0.0%	0.0%	0.0%	100.0%
Three		3	0	0	0	3
		100.0%	0.0%	0.0%	0.0%	100.0%
Four		0	3	0	0	3
		0.0%	100.0%	0.0%	0.0%	100.0%
Five		0	3	0	0	3
		0.0%	100.0%	0.0%	0.0%	100.0%
Six		0	0	3	0	3
		0.0%	0.0%	100.0%	0.0%	100.0%
Seven		0	0	0	3	3
		0.0%	0.0%	0.0%	100.0%	100.0%
Eight		0	0	0	3	3
		0.0%	0.0%	0.0%	100.0%	100.0%
Nine		0	0	0	3	3
		0.0%	0.0%	0.0%	100.0%	100.0%
Ten		0	0	0	3	3
		0.0%	0.0%	0.0%	100.0%	100.0%
Total		9	6	3	12	30
		30.0%	20.0%	10.0%	40.0%	100.0%

Table 2: Significant statistical association between light intensity 100nm and CHX conc. 0.12% using Pearson chi-square test and P value 0.001.

Table 3 and figure 13 showed correlation between light intensity 100 nm, CHX 0.02% and color change; there was statistically significant association between light cure 100 nm, CHX 0.02% and color change of composite during the course of ten study days. There wasn't any change in color through the 1st to 6th days, then only mild change happened over the 7th and 8th days followed by moderate change in the last 2 days. There was no severe change in this model. Pearson chi-square test was done and P-value was 0.001, this one has the least effect due to the lowest CHX conc. 0.02%.

Days	Light intensity 100, chlorhexidine 0.02%			
	No change	Mild	Moderate	Total
One	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Two	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Three	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Four	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Five	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Six	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Seven	0	3	0	3
	0.0%	100.0%	0.0%	100.0%
Eight	0	3	0	3
	0.0%	100.0%	0.0%	100.0%
Nine	0	0	3	3
	0.0%	0.0%	100.0%	100.0%
Ten	0	0	3	3
	0.0%	0.0%	100.0%	100.0%
Total	18	6	6	30
	60.0%	20.0%	20.0%	100.0%

Table 3: Correlation between light intensity 100 nm, chlorhexidine 0.02% and color change over ten days duration, P: 0.001 statistically significant relationship between light intensity 100 nm, CHX 0.02% and color change over 10 days duration using Pearson chi-square test and P value 0.001.

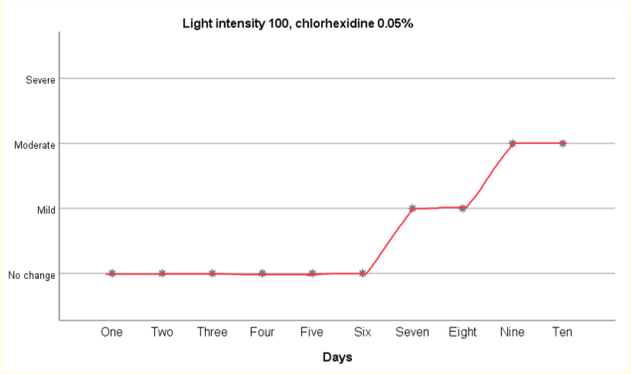

Figure 13: Correlation between light intensity 100 nm, chlorhexidine 0.02% and color change over ten days duration.

Light cure intensity 300 nm

Table 4 and figure 14 showed correlation between light intensity 300 nm, CHX 0.2% and color change, there was statistically significant relationship between light cure intensity 300 nm and CHX 0.2% and color change of composite over the course of ten study days. There wasn't any change in the color for the first 2 days, then a mild change in color happened during the 3rd and 4th days, the change became moderate through 5th - 7th days and finally severely changed on the 8th day on ward. Pearson chi-square test was used and P-value was 0.001, if we compare this result with 100 nm we can see that it has lower effect, this change is due to increase in light intensity.

Days	Light intensity 300, chlorhexidine 0.2%				
	No change	Mild	Moderate	Severe	Total
One	3	0	0	0	3
	100.0%	0.0%	0.0%	0.0%	100.0%
Two	3	0	0	0	3
	100.0%	0.0%	0.0%	0.0%	100.0%
Three	0	3	0	0	3
	0.0%	100.0%	0.0%	0.0%	100.0%
Four	0	3	0	0	3
	0.0%	100.0%	0.0%	0.0%	100.0%
Five	0	0	3	0	3
	0.0%	0.0%	100.0%	0.0%	100.0%
Six	0	0	3	0	3
	0.0%	0.0%	100.0%	0.0%	100.0%
Seven	0	0	3	0	3
	0.0%	0.0%	100.0%	0.0%	100.0%
Eight	0	0	0	3	3
	0.0%	0.0%	0.0%	100.0%	100.0%
Nine	0	0	0	3	3
	0.0%	0.0%	0.0%	100.0%	100.0%
Ten	0	0	0	3	3
	0.0%	0.0%	0.0%	100.0%	100.0%
Total	6	6	9	9	30
	20.0%	20.0%	30.0%	30.0%	100.0%

Table 4: Significant correlation between light intensity 300nm, chlorhexidine 0.2% and color change over ten days duration at P 0.001 using Pearson chi-square test and P value 0.001.

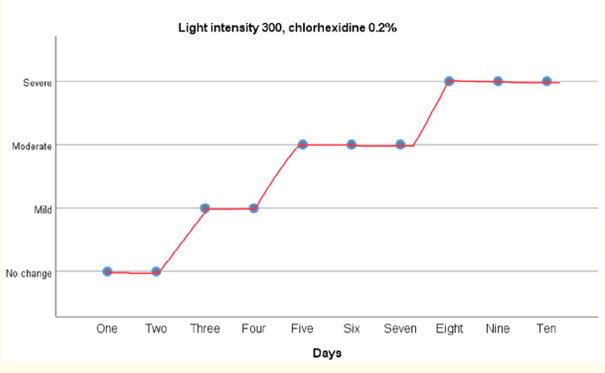

Figure 14: Correlation between light intensity 300 nm, chlorhexidine 0.2% and color change over ten days duration.

Table 5 and figure 15 revealed the correlation between light intensity 300 nm, CHX 0.12% and color change, there was statistically significant relationship between 300 nm intensity and 0.12% CHX. Conc. and color change of composite over the course of 10 study days. There wasn't any change in color for the first 4 days, then a mild change in color happened during the 5th and 6th days, the change became moderate on the 7th, 8th, 9th days and finally severely changed on the 10th day. Pearson chi-square test was done and P-value was 0.001, by decreasing CHX Conc. less color change happened.

	Light intensity 300, chlorhexidine 0.12%				
Days	No change	Mild	Moderate	Severe	Total
One	3	0	0	0	3
	100.0%	0.0%	0.0%	0.0%	100.0%
Two	3	0	0	0	3
	100.0%	0.0%	0.0%	0.0%	100.0%
Three	3	0	0	0	3
	100.0%	0.0%	0.0%	0.0%	100.0%
Four	3	0	0	0	3
	100.0%	0.0%	0.0%	0.0%	100.0%
Five	0	3	0	0	3
	0.0%	100.0%	0.0%	0.0%	100.0%
Six	0	3	0	0	3
	0.0%	100.0%	0.0%	0.0%	100.0%
Seven	0	0	3	0	3
	0.0%	0.0%	100.0%	0.0%	100.0%
Eight	0	0	3	0	3
	0.0%	0.0%	100.0%	0.0%	100.0%
Nine	0	0	3	0	3
	0.0%	0.0%	100.0%	0.0%	100.0%
Ten	0	0	0	3	3
	0.0%	0.0%	0.0%	100.0%	100.0%
Total	12	6	9	3	30
	40.0%	20.0%	30.0%	10.0%	100.0%

Table 5: Statistically significant correlation between light intensity 300 nm, chlorhexidine 0.12% and color change over ten days duration using Pearson chi-square test at P. 0.001 level.

Table 6 and figure 16 revealed the correlation between light intensity 300 nm CHX 0.02% and color change, there was statistically significant correlation between using 300 nm light cure and CHX 0.02% on composite over the course of 10 study days. There was no change in color through the 1st - 8th days, then a mild change happened on the 9th day, the change became moderate on the 10th day. There was no severe change in this model. Pearson chi-square test was done and p-value was 0.001, least CHX. Conc. least change in color happened.

	Light intensity 300, chlorhexidine 0.02%			
Days	No change	Mild	Moderate	Total
One	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Two	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Three	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Four	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Five	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Six	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Seven	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Eight	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Nine	0	3	0	3
	0.0%	100.0%	0.0%	100.0%
Ten	0	0	3	3
	0.0%	0.0%	100.0%	100.0%
Total	24	3	3	30
	80.0%	10.0%	10.0%	100.0%

Table 6: Statistically significant correlation between light intensity 300 nm, chlorhexidine 0.2% and color change over ten days duration using chi-square test at p. 0.001 level.

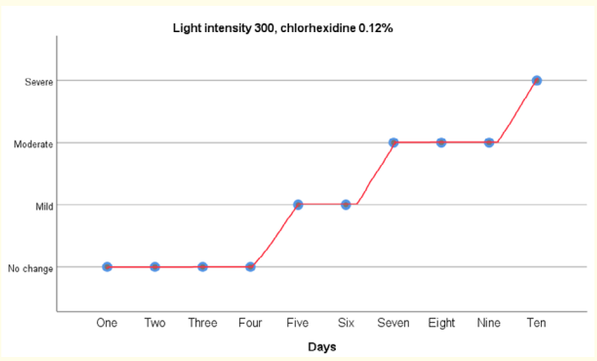

Figure 15: Significant correlation between light intensity 300 nm, chlorhexidine 0.12% and color change over ten days duration using Pearson chi-square test at P = 0.001 level.

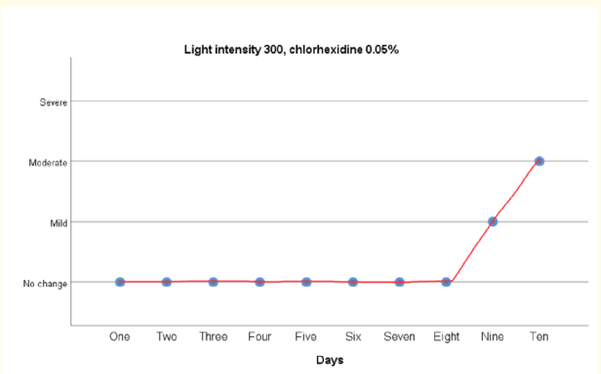

Figure 16: Statistically significant correlation between light intensity 300 nm, chlorhexidine 0.2% and color change over ten days duration at p.001 level using Pearson chi-square test.

Light cure intensity 600 nm

Table 7 and figure 17 showed correlation between light intensity 600 nm, CHX Conc. 0.2% and color change of composite over the course of 10 study days. There wasn't any change in color for the 1st three days, then only mild changes happened over the 4th, 5th and the 6th days, the change became moderate on the 7th day and finally severely changed on the 8th day onward. Pearson chi-square test wasn't done and p-value was 0.001 by increasing light intensity lesser change happened.

	Light intensity 600, chlorhexidine 0.2%				
Days	No change	Mild	Moderate	Severe	Total
One	3	0	0	0	3
	100.0%	0.0%	0.0%	0.0%	100.0%
Two	3	0	0	0	3
	100.0%	0.0%	0.0%	0.0%	100.0%
Three	3	0	0	0	3
	100.0%	0.0%	0.0%	0.0%	100.0%
Four	0	3	0	0	3
	0.0%	100.0%	0.0%	0.0%	100.0%
Five	0	3	0	0	3
	0.0%	100.0%	0.0%	0.0%	100.0%
Six	0	3	0	0	3
	0.0%	100.0%	0.0%	0.0%	100.0%
Seven	0	0	3	0	3
	0.0%	0.0%	100.0%	0.0%	100.0%
Eight	0	0	0	3	3
	0.0%	0.0%	0.0%	100.0%	100.0%
Nine	0	0	0	3	3
	0.0%	0.0%	0.0%	100.0%	100.0%
Ten	0	0	0	3	3
	0.0%	0.0%	0.0%	100.0%	100.0%
Total	9	9	3	9	30
	30.0%	30.0%	10.0%	30.0%	100.0%

Table 7: Statistically significant correlation between light intensity 600 nm, chlorhexidine 0.2% and color change over ten days duration at P value 0.001 using Pearson chi-square test and P value 0.001.

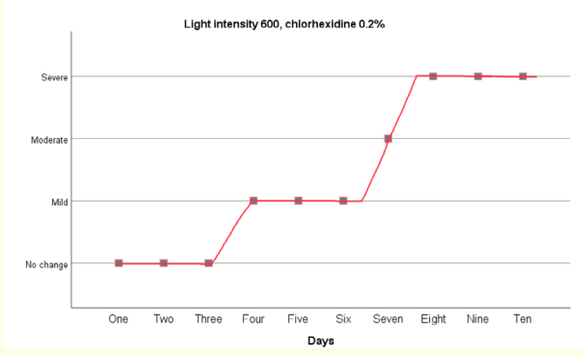

Figure 17: Correlation between light intensity 600 nm, chlorhexidine 0.2% and color change over ten days duration.

Table 8 and figure 18 showed correlation between light intensity 600 nm, CHX Conc. 0.12% and color change of composite over the course of 10 study days, there was statistical significant correlation between light intensity 600 nm and CHX. Conc. 0.12% on composite, there wasn't any change in color for the 1st 6 days, the only mild change happened over the 7th, 8th and 9th days, the change became moderate on the 10th day. There was no severe change in this model. Pearson chi-square test was done and p-value was 0.001, by decreasing CHX Conc. less color change happened.

	Light intensity 600, chlorhexidine 0.12%			
Days	No change	Mild	Moderate	Total
One	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Two	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Three	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Four	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Five	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Six	3	0	0	3
	100.0%	0.0%	0.0%	100.0%
Seven	0	3	0	3
	0.0%	100.0%	0.0%	100.0%
Eight	0	3	0	3
	0.0%	100.0%	0.0%	100.0%
Nine	0	3	0	3
	0.0%	100.0%	0.0%	100.0%
Ten	0	0	3	3
	0.0%	0.0%	100.0%	100.0%
Total	18	9	3	30
	60.0%	30.0%	10.0%	100.0%

Table 8: Statistical significant correlation between light intensity 600nm, chlorhexidine 0.12% and color change over ten days duration at p.001 level using Pearson chi-square test and P value 0.001.

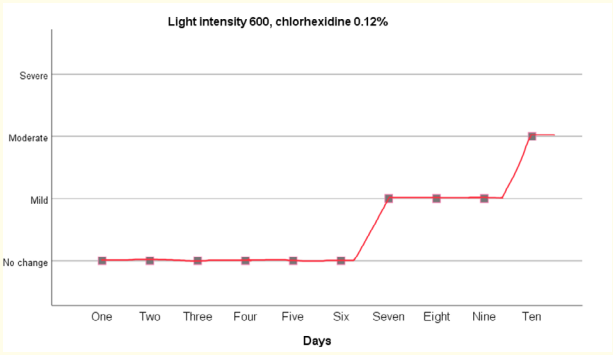

Figure 18: Correlation between light intensity 600 nm, chlorhexidine 0.12% and color change over ten days duration.

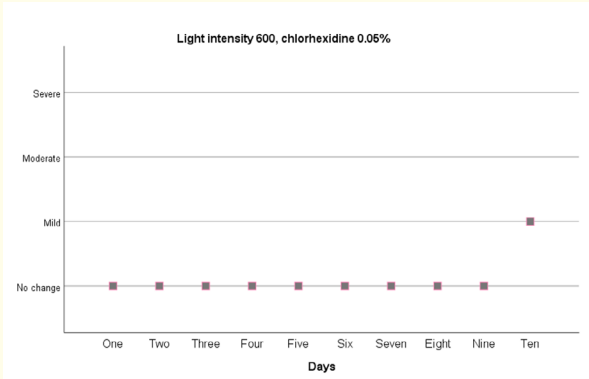

Figure 19: Correlation between light intensity 100 nm, chlorhexidine 0.02% and color change over ten days duration.

Table 9 and figure 19 showed correlation between light intensity 600 nm, CHX 0.02% and color change, there was statistically significant correlation between using light cure 600 nm and 0.02% CHX Conc. composite over the course of 10 study days. For the vast majority of the study days, there wasn't any change in composite color, the only change happened was mild at the last day. There was no moderate or severe change in this model. Pearson chi-square test wasn't done and p-value was 0.002% by decreasing CHX Conc. less color change happened.

	Light intensity 600, chlorhexidine 0.02%		
Days	No change	Mild	Total
One	3 (100%)	0 (0%)	3 (100%)
Two	3 (100%)	0 (0%)	3 (100%)
Three	3 (100%)	0 (0%)	3 (100%)
Four	3 (100%)	0 (0%)	3 (100%)
Five	3 (100%)	0 (0%)	3 (100%)
Six	3 (100%)	0 (0%)	3 (100%)
Seven	3 (100%)	0 (0%)	3 (100%)
Eight	3 (100%)	0 (0%)	3 (100%)
Nine	3 (100%)	0 (0%)	3 (100%)
Ten	0 (0%)	3 (100%)	3 (100%)
Total	27 (90%)	3 (10%)	30 (100%)

Table 9: Statistically significant correlation between light intensity 100 nm, chlorhexidine 0.02% and color change over ten days duration using Pearson chi-square test at p 0.002% level.

Discussion

Burke and Qualtrough (1944) reported that (38%) of patients dissatisfaction with esthetic restorations concerns color [15]. Staining of potential of various mouth-rinses were evaluated for many kinds of restorative materials [16]. Due to the limitation of mechanical control of dental plaque, researchers have currently been focused on chemical mouth-rinses and evaluation of their effects [17]. The discoloration of tooth and restorative materials by chlorhexidine has been demonstrated in several studies [18,19]. In our study, after placing composite resin in CHX. mouth-rinse, color change was detected this result is in accordance with [20,21] who stated that mouth-rinses can significantly change the color of this material. In our study we also detected color change within few days, this result is in accordance with [22] who reported that CHX. gluconate mouth-rinse has staining effect of the natural dentition which is highest within the first few days of use of this *in-vivo* experimental study and in accordance with [23] who indicated that composites showed acceptable color change after 2 weeks of immersion in CHX. mouth-rinse.

Our current study showed that CHX. Conc. 0.2% has the highest color change percentage but [24] showed that the best surface corruption managed with 0.1% mouth-rinse conc., in contrast to [25] who reported that 0.12% CHX. Conc. led to the discoloration of composite which was not accepted clinically.

In general, the main influential factors in the discoloration of composite resins are divided into intrinsic and extrinsic factors. The intrinsic factors involve change in the resin material such as type of composite resin (filler content and size). The extrinsic factors are staining through the superficial or deep absorption of dyes due to the individuals such as medication and food stuff (e.g. tea, nicotine and CHX rinses), the most significant effect of CHX. is the discoloration of teeth and restorative material with nano-filled composite resins which were clinically reasonable so this result is in accordance with our study [26]. While it's in contrast with [27] who have found that although visually no perceptible mouth-rinses affect color stability and [21,28] who have shown that the effects of mouth-rinses on the color stability are not different from these of distilled water.

The appearance of the dentition is of a great concern to a large number of people seeking dental treatment. Teeth discolorations are usually unsightly especially in anterior areas of the mouth. In the current study, color changes were assessed visually due to difficulty of acquiring Easy-shade spectrometer which is used for assessment of dental enamel or colorimeters which reduces subjectivity error of color assessment with naked eye [29].

In our study, color differences were evaluated visually directly because human eye can detect verges of color changes so our result is in accordance with other studies [30-32].

In the current study, colored mouth-rinses were applied that had an effect on color change of composite which is in accordance with [30,33-35]. The most significant staining of the samples reported in our study was with CHX. Conc. 0.2% and light intensity (100 nm), this might be attributed to incomplete polymerization of the sample at the lower surface which may increase absorption of CHX. Dye [26,36-38].

Comparing this study with other studies which determine color change at the upper surface of prepared samples, the purpose of this study was to identify color change at the lower surface of the sample 2mm distance from the source of light cure using different intensities.

Different light intensities will give different depth of curing composite resin so deficiency of polymerization of composite at the lower surface of the sample will leave the composite with low conversion from monomer to polymer, the incomplete polymerization at the lower surface may be the cause for increase absorption of the dye which consequently discolor the restoration so this is the significant finding of this study.

In our study, considerable difference among light sources with advancing color changes had occurred, the most significant one was (100,300 nm) and the least one was (600 nm), considerable difference in degree of polymerization of composite resin at the lower surface compared with the upper surface which was near light source maybe the reason for increasing color change with different CHX. Conc. this result is in contrast with [35] who stated no considerable contrast among light sources on advancing color changes and firmness of composite resin achieved.

Conclusion

According to the results, color changes in composite resin were a function of composite resin and solution used for immersion (staining agents). CHX. mouth-rinse was observed to cause color changes in composite specially at the lower surfaces of the samples which were considered significantly clinically acceptable. By increasing light intensity of curing composite and by decreasing conc. of CHX. mouth-rinse we can minimize discoloration of restorations.

Clinical Recommendations

Dentists and patients need to be informed about the gradual color degradation that can be expected from restorations while they are subjected to different conditions and different media.

Dentists should instruct patients having resin composite restorations whether in posterior or anterior region to avoid high conc. CHX. mouth-rinse so for periodontal patient there are 2 choices:

Either delay patient till finishing period treatment for 10 days.

Or Repeating composite filling after treatment with high conc. CHX mouth-rinse.

It is preferable for dentist to apply and cure composite resin layer by layer not more than 1mm for light cure devices with low intensity, while with high intensity device e.g (600nm) 2mm should be the acceptable thickness.

Suggestions:

Future *in-vivo* studies should be considered to get more appropriate details.

Further studies using spectrophotometeric device are needed for detecting exact amount of discoloration.

Further studies using different types of composite resin are needed to detect the amount of discoloration.

Further studies are needed to investigate the impact of alcoholic content of CHX mouth-rinse on composite resin.

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