Effect of three different light curing units on the color stability of bleaching shades composites

Thesis
Submitted to the Faculty of Oral and Dental Medicine
Cairo University in Partial Fulfillment of the
Requirements for the Master Degree in
Operative Dentistry

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2010

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To my Family……

Acknowledgements

*First, grace and foremost thanks to **God** for blessing this work until it has reached its end, as a little part of Allah generous help throughout our life.*

*Words stand short when coming to express my grateful thanks and deepest appreciations to **Dr. Amira Farid Alzoghby**, Professor of Operative Dentistry, Faculty of Oral and Dental Medicine, Cairo University, for her kindness, continuous guidance, support and encouragement.*

*A special acknowledgement is due to **Dr. Mohammad Hussien Zaazou**, Assistant professor of Operative Dentistry, National research center, for his great help and motivation.*

*With the deepest gratitude I would like to thank **Dr. Dina Wafik Elkassas,** lecturer of Operative Dentistry, Faculty of Oral and Dental Medicine, Cairo University, for her support, unforgettable encouragement through the various stages of this work.*

LIST OF CONTENTS

	Page
Introduction……………………………………………………..	**1**
Review of Literature ……………………………...............	**3**
• Effect of different light curing units and photo-initiator systems on the color and physical properties of resin composite ……………………………...............………	**3**
• Effect of aging on the color stability and physical properties of resin composite ……………………..............	**10**
Aim of the Study ……………………………………………...	**23**
Materials and Methods………………………………………	**24**
Results………………………………………………………	**37**
Discussion……………………………………………………..	**56**
Summary and Conclusions………………………………..	**65**
References…………………………………………...……	**67**
Arabic Summary …. ………………………………...	—

LIST OF TABLES

		Page
Table 1:	*Variables of the study ……………………………………..*	**28**
Table 2:	*Interaction of variables……………………………………*	**28**
Table 3:	*The means, standard deviation (SD) values, results of ANOVA and Tukey's test for comparison between (L*) values before, after UV exposure, after immersion and after immersion & exposure*	44
Table 4:	*The means, standard deviation (SD) values, results of ANOVA and Tukey's test for comparison between (a*) values before, after UV exposure, after immersion and after immersion & exposure*	45
Table 5:	*The means, standard deviation (SD) values, results of ANOVA and Tukey's test for comparison between (b*) values before, after UV exposure, after immersion and after immersion & exposure*	46
Table 6:	*The means, standard deviation (SD) values, results of ANOVA and Tukey's test for comparison between (ΔE) values after UV exposure, after immersion and after immersion & exposure.*	51
Table (7):	*The means, standard deviation (SD) values, results of ANOVA and Tukey's test for comparison between the (ΔE) values for the nine groups.*	52
Table 8:	Results of regression analysis for the effect of curing mode, shade, intervention and their interactions on mean (ΔE).	53
Table 9:	The means, standard deviation (SD) of (ΔE) comparing between curing units regardless to the other variables in the study.	53
Table 10:	The means, standard deviation (SD) values of (ΔE) comparing between different resin composite shades used regardless to the other variables in the study.	54
Table 11:	The means,standard deviation (SD) values of (ΔE) comparing between different aging methods used regardless to the other variables in the study.	55

LIST OF FIGURES

Page

Fig. 1: Ivoclar-Vivadent Tetric N-ceram resin composite shades A3 Bleach L and Bleach M. **31**

Fig. 2: Poly-wave LED: Bluephase G2 **31**

Fig. 3: LED Bluephase C5 **32**

Fig. 4: Halogen curing unit (Cromalux-E) **32**

Fig. 5: 5- a: Weather chamber apparatus

5- b: Control keys of the Weather chamber **33**

Fig. 6: Spectrophotometer (Shimadzu, UV-3101 PC Schimadza corporation, 1991). **34**

Fig. 7: Specimen before curing; pressed between 2 glass slabs and 2 mylor strips. **34**

Fig. 8: Mold with cured specimen. **35**

Fig. 9: Split Teflon mold for easy removal of specimen. **35**

Fig. 10: Incubator (model 1545, Sheldon, England). **36**

Fig. 11: Bar chart showing the mean L* values of different composite shades cured using different light curing units before and after different aging methods. **44**

Fig. 12: Bar chart showing the mean a* values of different composite shades cured using different light curing units before and after

different aging methods.

Fig. 13: *Bar chart showing the mean b* values of different composite shades cured using different light curing units before and after different aging methods.* **46**

Fig. 14: *Bar chart showing the mean ΔE values of different composite shades cured using different light curing units after different aging methods.* **49**

Fig. 15: Bar chart showing the mean ΔE values comparing between different composite shades cured using different light curing units after different aging methods. **50**

Fig. 16: Bar chart showing comparison between the three curing units regardless to the other variables in the study. 53

Fig. 17: Bar chart showing comparison between different resin composite shades used regardless to the other variables in the study. 54

Fig. 18: Bar chart showing comparison between different aging methods used regardless to the other variables in the study. 55

Introduction

In modern dentistry patients demand extended beyond having a functional healthy dentition and is directed towards achieving an esthetic smile. It has been reported that, in United Kingdom 28% of people are dissatisfied by the appearance of their teeth **(Qualthough and Bruke., 1994)**, and in the United States of America 38% are dissatisfied with their tooth color **(Odioso et al, 2000)**. Thus bleaching procedures are gaining wider popularity, with variety of bleaching materials and techniques are now available.

Unfortunately the operator may be for granted to restore a bleached tooth. In response to professional demands to produce "bleaching friendly" lighter shades, bleaching shades resin composites were launched into the market. In those shades manufactures began to substitute alternative photoinitiators for camphorquinone (CQ). The bright yellow color of camphorquinone make it "esthetically incompatible" for incorporation into the lighter shade composites. The alternative photoinitiators; such as phenylpropanedione, called PPD and trimethylbenzoyl diphenylphoshine oxide, called Lucirin TPO, used by some of the manufacturers in their newer composites are claimed to be color neutral and therefore tend not to exhibit the yellowing characteristic of those containing CQ **(Arikawa et al, 2009)**.

In another track of technology in the dental field is the curing technology. It was regularly subjected to changes during the last decades, but meanwhile the light emitting diodes (LED) era is fully established **(Micali and Basting, 2004)**, LED curing lights use gallium nitride semiconductors that produce a blue light when subjected to an electrical current. One of the advantages of LEDs is that they consume very little energy during the light emitting process allowing them to be powered by rechargeable batteries. Recently, the second and the third generation of LEDs have been introduced. These new generations of LED have a higher power density and broader light spectrum, respectively, compared to the first previous generation of LED **(Voltarelli et al, 2009)**.

Color stability of resin composite materials is a prime request for successful and durable restoration. Discoloration of resin composite can be induced internally or externally **(Ertas et al, 2006)**. These internally induce discolorations are permanent and are related to the composition of the resin matrix, filler loading, particle size distribution **(Dietschi et al, 1994)**, as well as the type of photo- initiator system **(Park et al, 1999 & Matsumura et al, 2000)**. While the extrinsic factors for discoloration include staining by adsorption or absorption of colorants as a result of contamination from exogenous sources **(Abu-Bakr et al, 2000)**. The degree of staining susceptibility is closely related to hygiene, diet and smoking habits **(Ayad, 2007).** However the resin composite affinity for intrinsic and extrinsic discoloration is modulated by its conversion rate, physicochemical characteristics as well as its surface roughness **(Ertas et al, 2006)**.

Since the spectral absorption of the photoinitiators system should correlate with the emission profiles of dental curing units to enhance the polymerization reaction and the degree of conversion leading to more color stability **(Eldiwany et al, 1995)**, a question was raised, are bleaching shades composite compatible with recently introduced LED light curing units? Thus this study was carried out to elaborate the effect of three different light curing units on the color stability of bleaching shades resin composites.

Review of Literature

Effect of different light curing units and photo-initiator systems on the color and physical properties of resin composite:

Knezevic et al in 2001, compared the degree of conversion(dc) and temperature rise in 4 hybrid composite resin materials (Tetric ceram, Pertacп, Valux plus and Degufill mineral) using three different curing units: Heliolux QTH, Elipar high light soft start LED, Blue super bright LED. They found that there was no significant difference in (dc) values on using different curing units and that the halogen curing unit showed twice as temperature rise as the LEDs units. They concluded that it is safer to use LEDs in composite curing as it will produce less heat with no significant reduction in the degree of conversion of composite.

Price et al in 2003, made a comparison between QTH, LED and plasma arc curing units and their effect on the hardness of 5 types of resin composite.6 curing units were used; one plasma arc (Scapphire) ,three QTH (Optilux 501 standard, Optilux 501 turbo and phase 2) and 2 LED units (Versalix and Freelight) to cure 5 types of resin composite (Filtek Z250, solitaire2, P.C., pyramid dentin and pyramid enamel) Samples were made of thickness 2 mm and the hardness was measured at bottom and surface using Vicker's test. It was found that the QTH curing unit that produced the greatest energy also produced the hardest resin composite (Optilux 501 for 40 seconds). They concluded that LED curing units cannot adequately polymerize all resin composite shades and that when a resin composite receives inadequate total energy, the hardness is adversely affected and vice versa.

Micali and Basting in 2004, compared the efficiency of a commercial LED (Dabi atlante) with that of a halogen based light curing unit (Degussa huls) by means of dye penetration on a micro hybrid composite. The composite used was 3M Filtek Z250 which was cured for 40 seconds after dividing the samples into 2 groups, one cured by LED while the other by QTH. Immediately after curing the composite specimens were immersed in 2% methylene blue solution at 37°C for 24 hours then washed under running distilled water and the color was measured by the mean of an absorbance spectrophotometer. It was found that there was no significant difference between the composite cured by LED and that cured by QTH. It was concluded that the LED based light curing units are as effective in polymerizing the hybrid resin composite as the halogen based units.

Janda et al in 2004, examined the color stability of resin matrix restorative materials as a function of the method of light activation. Four types of resin composites were used; micro-filled resin: Durafill-Heraeus Kulzer, hybrid resin: Charisma-Heraeus Kulzer, Ormocer: Definite-Degudent and Compomer: Dycrat AP-Dentsply. The light curing units used were a tungsten halogen lamp (Translux Energy) and a plasma arc lamp (Apollo 95-E). Specimens were divided into two halves according to the curing unit used and each half was subdivided into three subgroups according to the time of curing, as for Translux groups 1,2 and 3 were cured for 20,40 and 60 seconds respectively, and for Apollo 95-E groups 4,5 and 6 were cured for 3, 10 and 20 seconds respectively. Baseline color was measured for all specimens by the means of a spectrophotometer, specimens were exposed to irradiation for 24 hours by a special Xenon lamp and color was re-measured. Color changes were calculated and recorded. All materials exposed to the Xenon irradiation were found to be bleached and that groups cured by Translux Dycrat AP cured for 20 seconds were bleached the most. All groups cured by Apollo 95-E dramatically lost yellow values after Xenon irradiation specially when cured for 3 seconds, bleaching was less for groups cured for 20 seconds, but still visible. They concluded that the dramatic bleaching effects that occurred after UV Xenon light exposure to resin composite cured by plasma arc indicates that plasma arc is not capable to fully polymerize composite despite of its much higher output than halogen lamp.

Gomes et al in 2006, studied the hardness of bleaching shade resin composite polymerized by different light curing sources. The resin composites used were of the same type (3M Filtek supreme) and were divided into 4 groups. Three groups were cured by 3 different commercial LED (3M Elipar freelight, Kerr L.E. Demetron, coltolux LED) with different power intensities (400, 1220, 540 mw/cm respectively) The fourth group was cured with QTH with a power intensity of 728 mw/cm. They tested the samples for micro hardness with a digital Vicker's micro hardness instrument from top and bottom surfaces. No significant difference was detected between different groups at the bottom surface, while at the top surface QTH light source group presented significant higher hardness values compared to 3M Elipar Freelight LED and coltolux LED and no significant difference from Kerr L.E. Demetron LED. They concluded that the power intensity of the light source is responsible for hardness not the irradiance source.

Pires-de-souza et al in 2007 studied the color stability of three resin composites (Tetric Ceram, Heliomolar and Esthet-X) of two different shades (A3 and C3) cured with either tungsten halogen or light emitting diode (LED). They used forty specimens (twenty for each shade, ten cured by halogen and ten cured by LED). Base line color measurements were recorded for each sample