

# **The Effect of Aging on Color stability and Translucency of two different ceramic Materials**

A thesis submitted to Fixed prothodontics department, Faculty of  
Dentistry, Ain Shams university for Partial fulfillment of the  
requirement for The Master Degree in Fixed Prosthodontics

**By**

**Ahmed Mohamed Abd Ellatif**

BDS Cairo University (2011)

Demonstrator of Fixed prosthodontics

Faculty of Dentistry, British university in Egypt

Faculty of Dentistry

Ain Shams university

2019



## **Supervisors**

### **Prof. Dr. Tarek Salah Morsy**

Professor and Head of Fixed Prosthodontics department

Faculty of Dentistry, Ain Shams University

### **Ass.Prof. Dr. Maged Mohamed Zohdy**

Associate Professor of Fixed Prosthodontics

Faculty of Dentistry, Ain Shams University



# ***Acknowledgment***

*First and Forever thanks and gratitude to **ALLAH***

*It is a great honor to express my sincere gratitude and appreciation to **Dr. Tarek Salah Morsi**, Head of department of Fixed Prothodontics, Faculty of Dentistry, Ain Shams University for his valuable guidance, expert assistance and powerful support.*

*I am greatly thankful to **Dr. Maged Mohamed Zohdy**, Associate Professor of Fixed Prothodontics, Faculty of Dentistry, Ain Shams University for his encouragement, patience and support during the work. I am very grateful and thankful for all the effort and time he gave me.*

*I would most like to thank all the British University staff members and colleagues in Fixed Prothodontics department whom participated in making this work possible. Special thanks should be given to **Dr. Omar elsergany, Dr. Fatma Makkeya, Dr. Engy Farag and Dr. Sarah Adel** for their helpful and valuable contribution.*



# ***Dedication***

*I lovingly dedicate this thesis to my dear **mother**,  
**my wife**, my **brother** and my **Son Youssef**.*

*And to **my father**, may Allah rest his soul in peace  
whom I wished to share me these unforgettable moments*



# Contents

<b><u>Introduction</u></b> .....	<b>1</b>
<b><u>Review of literature</u></b> .....	<b>3</b>
1. <u>Dental Ceramic restorations:</u> .....	3
1.1 <u>Monolithic restorations:</u> .....	4
1.2 <u>IPS e.max all-ceramic:</u> .....	5
1.3 <u>Zirconia Restorations:</u> .....	7
2. <u>Color:</u> .....	12
2.1 <u>Factors affecting color:</u> .....	14
2.2 <u>Reproduction of color:</u> .....	16
3. <u>Translucency:</u> .....	16
4. <u>Effect of thickness on the color and translucency:</u> .....	20
5. <u>Aging:</u> .....	24
5.1 <u>Thermocycling:</u> .....	24
5.2 <u>Accelerated Aging:</u> .....	27
<b><u>Statement of the problem</u></b> .....	<b>29</b>
<b><u>Study Objectives</u></b> .....	<b>30</b>
<b><u>Materials and Methods</u></b> .....	<b>31</b>
1. <u>Materials:</u> .....	31
1.1 <u>Lithium disilicate:</u> .....	31
1.2 <u>Ultra- translucent Zirconia:</u> .....	32
2. <u>Methods:</u> .....	34
2.1 <u>Sample grouping:</u> .....	34
2.2 <u>Samples preparation:</u> .....	35
2.2.1 <u>Emax CAD preparation:</u> .....	35
2.2.2 <u>Bruxzir anterior preparation:</u> .....	40
2.3 <u>Pre-Aging mesurments:</u> .....	45

2.4	<u>Evaluation of thermocycling effect:</u> .....	49
2.5	<u>Post Aging measures:</u> .....	50
	<b><u>Results</u></b> .....	<b>52</b>
	<b><u>Discussion</u></b> .....	<b>65</b>
	<b><u>Summary</u></b> .....	<b>72</b>
	<b><u>Conclusion</u></b> .....	<b>74</b>
	<b><u>References</u></b> .....	<b>75</b>

# **List of Tables**

<a href="#"><u>Table (1): Materials used in the study.....</u></a>	31
<a href="#"><u>Table (2): Standard composition of IPS e.max CAD .....</u></a>	32
<a href="#"><u>Table (3): Physical properties of IPS e.max CAD.....</u></a>	32
<a href="#"><u>Table (4): Standard composition of Bruxzir Anterior.....</u></a>	33
<a href="#"><u>Table (5): Physical properties of Bruxzir Anterior.....</u></a>	33
<a href="#"><u>Table (6): Sample grouping .....</u></a>	34
<a href="#"><u>Table (7): Descriptive statistics of color difference (<math>\Delta E</math>).....</u></a>	53
<a href="#"><u>Table (8): Two-Way ANOVA for the effect of ceramic type, specimen thickness and their interaction on color difference (<math>\Delta E</math>).....</u></a>	53
<a href="#"><u>Table (9): Mean <math>\pm</math> St. deviation and P-value for the effect of ceramic type and specimen thickness on color difference (<math>\Delta E</math>) after thermocycling.....</u></a>	55
<a href="#"><u>Table (10): Descriptive statistics of color parameters.....</u></a>	56
<a href="#"><u>Table (11): Mean <math>\pm</math> St. deviation and P-value for the effect of thermocycling on L* parameter.....</u></a>	56
<a href="#"><u>Table (12): Mean <math>\pm</math> St. deviation and P-value for the effect of thermocycling on a* parameter.....</u></a>	58
<a href="#"><u>Table (13): Mean <math>\pm</math> St. deviation and P-value for the effect of thermocycling on b* parameter.....</u></a>	60
<a href="#"><u>Table (14): Descriptive statistics of translucency parameter (TP)....</u></a>	61
<a href="#"><u>Table (15): Two-way ANOVA for the effect of ceramic type, specimen thickness and their interaction on translucency. .....</u></a>	61

Table (16): Mean  $\pm$  St. deviation and P-value for the effect of thermocycling on translucency parameter (TP)..... 62

Table (17): Mean  $\pm$  St. deviation and P-value for the percentage change (%) in translucency parameter after thermocycling. .... 64

# **List of Figures**

<a href="#"><u>Figure (1): E.max Block</u></a> .....	31
<a href="#"><u>Figure (2): Bruxzir Blank</u></a> .....	33
<a href="#"><u>Figure (3): VHF S1-axis milling machine</u></a> .....	35
<a href="#"><u>Figure (4): Crystallization program</u></a> .....	36
<a href="#"><u>Figure (5): E.max Block after Crystallization</u></a> .....	36
<a href="#"><u>Figure (6): IsoMetM 4000</u></a> .....	37
<a href="#"><u>Figure (7): Cutting of E.max Block</u></a> .....	38
<a href="#"><u>Figure (8): Finishing and Polishing Kit</u></a> .....	38
<a href="#"><u>Figure (9): Checking of 0.5mm thickness of the samples</u></a> .....	39
<a href="#"><u>Figure (10): Checking of 1mm thickness of the samples</u></a> .....	39
<a href="#"><u>Figure (11): Milling of bruxzir anterior blank</u></a> .....	40
<a href="#"><u>Figure (12): Bruxzir Block</u></a> .....	41
<a href="#"><u>Figure (13): Cutting of Bruxzir block</u></a> .....	42
<a href="#"><u>Figure (14): Samples on Sintering tray</u></a> .....	43
<a href="#"><u>Figure (15): Sintering cycle chart</u></a> .....	43
<a href="#"><u>Figure (16): Finishing and Polishing Kit</u></a> .....	44
<a href="#"><u>Figure (17): Checking 0.5mm of the thickness of the samples</u></a> .....	44
<a href="#"><u>Figure (18): Checking 1mm of the thickness of the sample</u></a> .....	45
<a href="#"><u>Figure (19): Aligent Cary 5000 spectrophotometer</u></a> .....	47
<a href="#"><u>Figure (20): Black disk placed in the front port of the sphere</u></a> .....	47
<a href="#"><u>Figure (21): Placement of the sample in the device</u></a> .....	48
<a href="#"><u>Figure (22): THE-1100 SD Mechantroniks thermocyler machine</u></a> ...	50
<a href="#"><u>Figure (23): Effect of ceramic type and specimen thickness on color difference (<math>\Delta E</math>) after thermocycling</u></a> .....	55
<a href="#"><u>Figure (24): Effect of thermocycling on change in L* parameter</u></a> ...	57

[Figure \(25\): Effect of thermocycling on change in a\\* parameter](#) .... 59

[Figure \(26\): Effect of thermocycling on change in b\\* parameter](#).... 60

[Figure \(27\): Effect of thermocycling on change in translucency parameter \(TP\)](#)..... 63

[Figure \(28\): The percentage change \(%\) in translucency parameter after thermocycling](#)..... 64

# **Introduction**

Along the past years dentistry has gone through numerous developments in knowledge, techniques and technology. Among many of the more recent challenges is to achieve the best esthetics. For the optimal esthetics, it is important for restorations to reproduce not only the color but also the translucency of the natural tooth.

In order to get a satisfied shade match for a restoration, there are three parameters of color; hue, chroma, and value that should be considered where the shade difference between a restoration and its surrounding teeth should be indistinguishable. Moreover, there is a fourth element which is translucency considered to be an important factor in selection of restorative materials. Translucency is the property of a substance that permits the passage of light, but also disperses the light. The translucency of a restorative material provides an added “lifelike” vitality and a natural appearance to the completed restoration.

The most important goal of the restorative dentist is to restore a tooth structure to its natural form, function, and appearance at an acceptable level so as to positively impact the patient's satisfaction.

Little is known about color changes in ceramic restorations over time, as investigators focused on the mechanical properties of the material. However, the adverse conditions of the oral environment may cause changes in the physical properties of the material.<sup>[1]</sup>