



قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا
عَلَّمْتَنَا إِنَّكَ أَنْتَ
الْعَلِيمُ الْحَكِيمُ

صدق الله العظيم

(سورة البقرة)

الآية « ٣٢ »

CHEMICAL DURABILITY OF CERAMIC RESTORATION (IN VITRO STUDY)

Submitted to the Faculty of Oral and Dental Medicine, Cairo University
For the Partial Fulfillment of the Requirement of the Master Degree
in Fixed Prosthodontics

By

Hossam Ahmed Mosa Ghorap

B. D .S (Cairo)

Faculty of Oral and Dental Medicine

Cairo University

Faculty of Oral and Dental Medicine

Cairo University

2007

SUPERVISORS

Prof. Dr. Omaila Salah El-Din El-Mahallawi

Professor of Crown and Fixed Prosthodontics

Faculty of Oral and Dental Medicine

Cairo University

Prof. Dr. Dorya M. Mahmood Ibrahim

Professor of Ceramic , Refractories and Building

Materials, National Research Center

Cairo

Assist. Prof. Dr. Mohamed Labib Zamzam

Assistant Professor of Crown and Fixed Prosthodontics

Faculty of Oral and Dental Medicine

Cairo University

الاستمرارية الكيميائية للترميم الخزفي (دراسة معملية)

رسالة مقدمة إلى

كلية طب الأسنان – جامعة القاهرة

للحصول على

درجة الماجستير فرع التركيبات الثابتة

مقدمة من

الطبيب/ حسام أحمد موسى غراب

بكالوريوس طب وجراحة الفم والأسنان
كلية طب الفم والأسنان
جامعة القاهرة

كلية طب الأسنان

جامعة القاهرة

٢٠٠٧

المشرفون

الأستاذة الدكتورة/ أميمة صلاح الدين المحلاوى

أستاذ بقسم التيجان والجسور
كلية طب الفم والأسنان – جامعة القاهرة

الأستاذة الدكتورة/ درية محمد إبراهيم

أستاذ السيراميك بقسم الحراريات وخواص مواد البناء
بالمركز القومى للبحوث
القاهرة

الدكتور/ محمد لبيب زمزم

أستاذ مساعد بقسم التيجان والجسور
كلية طب الفم والأسنان – جامعة القاهرة

List of Contents

Contents	Page No.
Introduction	1
Review of Literature	3
Aim of the Study	30
Materials and Methods	31
Results	54
Discussion	111
Summary	119
Conclusion and Recommendation	123
References	125
Arabic summary	

List of Figures

Figure	Page No.
(1) Scanning electron microscopy	35
(2) EDAX unit	35
(3) Copper mold	37
(4) Samples of ceramic discs	38
(5) Firing schedule for VMK95 ceramic	41
(6) Firing schedule for VM7 ceramic	41
(7) Firing schedule for Empress 2 ceramic	42
(8) Grouping of the specimens	44
(9) Hot Air Dissecator	46
(10) Standard balance of 6 digits	46
(11) Incubator	47
(12) Digital pH meter	47
(13) Inductively coupled plasma atomic spectrometer	50
(14) Sputtering chamber	52
(15) XRD pattern of the three ceramic materials before immersion	55
(16) EDS of VMK95 ceramic before and after immersion	56
(17) EDS of VM7 ceramic before and after immersion	57
(18) EDS of Empress2 ceramic before and after immersion	58

(19) Effect of type of material on average weight loss percentage at different pHs for various periods of immersion	64
(20) Effect of pH values on average weight loss percentage of the three ceramic materials at various periods of immersion	69
(21) Effect of period of immersion on average weight loss % of VMK95 at different pH values	71
(22) Effect of period of immersion on average weight loss % of VM7 at different pH values	73
(23) Effect of period of immersion on average weight loss % of Empress2 at different pH values	75
(24) Concentration of Na⁺ ions leached from the three ceramic materials	81
(25) Concentration of Mg²⁺ ions leached from the three ceramic materials	81
(26) Concentration of Ca²⁺ ions leached from the three ceramic materials	82
(27) Concentration of K⁺ ions leached from the three ceramic materials	82
(28) Concentration of Al³⁺ ions leached from the three ceramic materials	83
(29) Effect of pH values on leached ions from VMK95 ceramic at different periods of immersion	87
(30) Effect of pH values on leached ions from VM7 ceramic at different periods of immersion	90

(31) Effect of pH values on leached ions from Empress 2 ceramic at different periods of immersion	93
(32) Effect of period of immersion on the leached ions from VMK95 ceramic	95
(33) Effect of period of immersion on the leached ions from VM7 ceramic	97
(34) Effect of period of immersion on the leached ions from Empress 2 ceramic	99
(35) Digital camera photographs of the three types of ceramic after immersion in solution of pH2.2 for 30 days at 80°C (stained with dye)	101
(36) Polarized light microscope micrograph of VMK95 after immersion in solution of pH2.2 for 30 days at 80°C : 170X	103
(37) Polarized light microscope micrograph of VM7 after immersion in solution of pH2.2 for 30 days at 80°C : 170X	104
(38) Polarized light microscope micrograph of Empress 2 after immersion in solution of pH2.2 for 30 days at 80°C : 170X	105
(39) : SEM image of VMK95 ceramic before and after immersion	108
(40) SEM image of VM7 ceramic before and after immersion	109
(41) SEM image of Empress2 ceramic before and after immersion	110

List of Tables

Table	Page No.
(1) The three types of dental ceramic materials studied	31
(2) pH values of some common solutions	32
(3) Firing schedule for VMK95 ceramic	40
(4) Firing schedule for VM7 ceramic	40
(5) Firing schedule for Empress 2 ceramic	40
(6) The proportions of the prepared solutions	48
(7) EDS of VMK95 before and after corrosion	56
(8) EDS of VM7 before and after corrosion	57
(9) EDS of Empress2 before and after corrosion	58
(10) The means, standard deviation values and results of ANOVA and Duncan's for the comparison of average weight loss of the three ceramic materials at different pH values for various periods of immersion	63
(11) The means, standard deviation values and results of ANOVA and Duncan's test for the comparison between the effect of pH values on average weight loss percentage of the three types of ceramics	68
(12) The means, standard deviation values and results of paired t-test for the effect of period of immersion on average mass loss percentage of VMK95 ceramic	71
(13) The means, standard deviation values and results of paired t-test for the effect of period of immersion on average weight loss percentage of VM7 ceramic at different pH values	72

(14) The means, standard deviation values and results of paired t-test for the effect of period of immersion on average weight loss percentage of Empress 2 ceramic at different pH values	74
(15) The means, standard deviation values and results of ANOVA and Duncan's test for the leached ions at different pH value and period of immersion	79
(16) The means, standard deviation values and results of ANOVA and Duncan's test for The effect of pH values on the leached ions from VMK95 ceramic at different periods of immersion	87
(17) The means, standard deviation values and results of ANOVA and Duncan's test for The effect of pH values on the leached ions from VM7 ceramic at different periods of immersion	90
(18) The means, standard deviation values and results of ANOVA and Duncan's test for The effect of pH values on the leached ions from Empress2 ceramic at different periods of immersion	93
(19) The mean standard deviation values and results of paired t-test for the effect of period of immersion on leaching of ions from VMK95 ceramic	94
(20) The mean standard deviation values and results of paired t-test for the effect of period of immersion on the leached ions from VM7 ceramic	96
(21) The mean standard deviation values and results of paired t-test for the effect of period of immersion on the leached ions from Empress2 ceramic	98

INTRODUCTION

Aim of the Study

Review of Literature

Materials
&
Methods