

Shear Bond Strength of Translucent Zirconia and Lithium-Disilicate Glass Ceramic to Dentin using Three Different Surface Treatments

**Thesis submitted for Partial Fulfillment of the
Requirements of Master Degree in Crown and Bridge
Faculty of Dentistry, Ain Shams University**

BY

Sherihan Abdel-Moniem El-Zayat

**B. D. Sc., Faculty of Dentistry,
Ain Shams University (2006)**

**Faculty of Dentistry
Ain Shams University
2013**

Supervisors

Dr. Jihan Farouk Mohamed Younis

Assistant Professor of Crown and Bridge Department,

Ain Shams University

Dr. Marwa Mohamed Wahsh

Lecturer of Crown and Bridge Department,

Ain Shams University

ACKNOWLEDGEMENT

*First and foremost thanks are due to
Allah the beneficent and merciful*

I would like to express my deepest gratitude to **Dr. Jihan Farouk Younis**, Assistant Professor of fixed prosthodontics, Ain Shams University, for encouragement, insight and advice. She gave from her scientific knowledge, experience, effort and most of all her valuable time. It was a great honor to work under her supervision.

I would like to express my heartfelt thanks and deep gratitude to **Dr. Marwa Mohamed Wahsh**, Lecturer of fixed prosthodontics, Ain Shams University, for her valuable unlimited guidance, constructive criticism, friendly assistance and great skills in writing scientific text. I was honored to have her as my supervisor throughout this research work.

Personal appreciation and thanks to **Dr. Tarek Salah Morsi**, Assistant Professor of fixed prosthodontics, head of crown and bridge department, Ain Shams University, for his effort, cooperation and valuable advice whenever asked.

I am endlessly grateful to **Dr. Ayman Galal Eldimeery**, Lecturer of fixed prosthodontics, Ain Shams University, for his extreme help and valuable advice whenever asked. For him I will remain eternally indebted.

Special thanks to **Dr. Ahmed Aboulfadl**, Assistant lecturer of fixed prosthodontics, Ain Shams University, for her kindness and support.

I wish to extend my sincere thanks to my best friends for their support in the good as well as the bad days.

Finally, I would like to thank all my colleagues who helped and encouraged me to complete this thesis.

DEDICATION

This work is dedicated to

*My Family, for their great care, support and
guidance all the way in my life.*

*And to my best friends who helped me a lot to
complete this work*

CONTENTS

List of tables	i
List of figures.....	ii
Introduction	1
Review of literature.....	3
Aim of the study	35
Materials and methods	37
Results	65
Discussion	77
Summary and conclusions.....	89
References	91
Arabic summary.....	

LIST OF TABLES

Table No.	Title	Page No.
Table 1	Factorial Experimental Design.....	41
Table 2	Maximum load in lithium disilicate glass ceramic	66
Table 3	Maximum load in translucent zirconia glass ceramic...	67
Table 4	Maximum load in all groups	69
Table 5	Difference in maximum load of the materials in relation to the surface treatment	70
Table 6	A summary of the modes of specimens failure	71

LIST OF FIGURES

Figure No.	Title	Page No.
Figure 1	Translucent zirconia blocks	37
Figure 2	Resin cement kit.....	37
Figure 3	Hydrofluoric acid etch (Ultradent).....	38
Figure 4	Silane coupling agent (Ultradent)	38
Figure 5	Intact human molar	39
Figure 6	Intact human molar	39
Figure 7	Guiding grooves showing dentin	39
Figure 8	Flattened dentinal occlusal surface	40
Figure 9	Occlusally flattened molar in the plastic tube.....	40
Figure 10	sprue wax.....	42
Figure 11	Sprue on ring.....	42
Figure 12	Invested ring	43
Figure 13	IPS Emax press ingot	44
Figure 14	Press firing furnace	45
Figure 15	Pressed ring.....	45
Figure 16	Divested ingot.....	46
Figure 17	Cleaned press	47
Figure 18	Separated discs.....	47
Figure 19	2mm Disc Thickness with Boley Gauge	48
Figure 20	Cerec system.....	48
Figure 21	specially designed Teflon mold	49
Figure 22	Cerec optispray	50

Figure No.	Title	Page No.
Figure 23	Determining insertion axis	51
Figure 24	Optical impression	51
Figure 25	Trim preparation	52
Figure 26	Trim preparation	52
Figure 27	Editing preparation margin	52
Figure 28	Milling preview	53
Figure 29	Milling preview	53
Figure 30	Milling preview	53
Figure 31	Cerec Inlab MC XL milling unit	54
Figure 32	Clicking ok to start machining	54
Figure 33	Checking the milled disc by metal gauge caliber	55
Figure 34	Etching of the ceramic disc	56
Figure 35	Silanization of the ceramic disc.....	57
Figure 36	Cojet system.....	57
Figure 37	Loading device	59
Figure 38	Dispensing the resin cement.....	60
Figure 39	Mixing the resin cement.....	60
Figure 40	The specimen in the loading device.....	61
Figure 41	Curing of the resin cement	61
Figure 42	Storage of the specimens in distilled water.....	62
Figure 43	Universal testing machine	63
Figure 44	Sample mounted onto the testing machine	63

Figure No.	Title	Page No.
Figure 45	Sample mounted onto the testing machine (closer view).....	63
Figure 46	Maximum load in lithium disilicate glass ceramic	66
Figure 47	Maximum load in translucent zirconia glass ceramic ...	68
Figure 48	Maximum load in all groups.....	69
Figure 49	Translucent zirconia treated with air abrasion showing adhesive failure (more than 50% of the resin cement is adherent on the ceramic disc)	72
Figure 50	Translucent zirconia treated with hydrofluoric acid showing adhesive failure between resin and ceramic ...	72
Figure 51	Translucent zirconia treated by cojet system showing cohesive layer within the resin cement (cohesive failure)	73
Figure 52	Translucent zirconia (control group) showing adhesive failure between ceramic and resin	73
Figure 53	Lithium disilicate treated by air abrasion showing mixed mode of failure	74
Figure 54	Lithium disilicate treated by hydrofluoric acid showing adhesive failure (almost all the resin cement is adherent on the ceramic disc).....	74
Figure 55	Lithium disilicate treated by cojet system showing mixed mode of failure	75
Figure 56	Lithium disilicate (control group) showing adhesive failure between resin and ceramic	75

INTRODUCTION

For decades, the first objective of anterior dental restorations has been to replace tooth structure lost by dental disease in an esthetic manner. Improvements in dental techniques and materials have led to the development of all ceramic restorations¹, which are well suited to change the shape and color of teeth^{2,3}.

Dental restorations using all ceramic materials in association with adhesive cements have become popular, primarily because of esthetic properties such as translucency, fluorescence & opalescence that better simulate the appearance of natural dentition. Other desirable characteristics include chemical stability, a coefficient of thermal expansion similar to dentin, biocompatibility & high compressive strength^{4,5}.

The technological evolution of ceramics for dental applications has been remarkable, as new materials and processing techniques are steadily being introduced. The improvement in both strength and toughness has made it possible to expand the range of indications to long-span fixed partial prostheses, implant abutments and implants⁶.

Driven by a debatable need for metal-free restorations, the evolution of all ceramic systems for dental restorations has been remarkable. Processing techniques novel to dentistry have been developed, such as heat-pressing, slip-casting and Computer Aided Design – Computer Aided Machining (CAD-CAM)⁷.

The ceramic composition of an all ceramic restoration is an important component of an effective bonding. Lithium-disilicate glass ceramic is an etchable ceramic due to its glass content. However,