

بسم الله الرحمن الرحيم

"قالوا سبحانك لا علم لنا الا ما علمتنا انك انت العليم

الحكيم"

صدق الله العظيم

سورة البقرة : الآية ٣٢

***Evaluation of Nanofilled and Silorane
Composite Esthetic Materials in the
Restoration of Primary Molars***

Thesis

*submitted to the Faculty of Oral and Dental Medicine,
Cairo University*

*In Partial Fulfillment of the Requirements
Of Doctor's Degree in Pediatric Dentistry*

By

Sherine Shehata Mohamed Badawy

*Assistant lecturer of Pediatric Dentistry,
October 6 University*

B.D.S (2001) Cairo University

M.Sc. (2007) Cairo University

Faculty of Oral & Dental Medicine

Cairo University

2013

SUPERVISORS

Prof. Dr. Kamal M. El-Motayam

***Professor in Pediatric Dentistry and Dental Public
Health Department
Faculty of Oral and Dental Medicine
Cairo University***

Prof. Dr. Hala M. Abbas

***Professor in Pediatric Dentistry and Dental Public
Health Department
Faculty of Oral and Dental Medicine
Cairo University***

Prof. Dr. Ola M. Omar

***Professor in Pediatric Dentistry and Dental Public
Health Department
Faculty of Oral and Dental Medicine
Cairo University***

Acknowledgement

I would like to express my sincere gratitude to ***Prof. Dr. Kamal El-Motayam*** Professor in Pediatric Dentistry and Dental Public Health Department, Faculty of Oral and Dental Medicine, Cairo University, for his guidance, support, directions and continuous encouragement throughout this work. I was greatly honored working under his supervision.

No words could be sufficient for expressing my sincere appreciation to ***Prof. Dr. Hala M. Abbas*** Professor in Pediatric Dentistry and Dental Public Health Department, Faculty of Oral and Dental Medicine, Cairo University, for her help, encouragement, patience and constructive efforts during conducting this study, and I was greatly honored working under her supervision.

A very special acknowledgement for ***Prof. Dr. Ola M. Omar*** Professor in Pediatric Dentistry and Dental Public Health Department, Faculty of Oral and Dental Medicine, Cairo University, for her help, motivation, meticulous supervision and unique cooperation through the various stages of this study. It has been my privilege and almost pleasure to conduct this work under her supervision.

My thanks are extended to ***the staff members of Pediatric Dentistry and Dental Public Health Department***, Faculty of Oral and Dental Medicine, Cairo University.

My deepest thanks are extended to *the staff members of Pediatric Dentistry and Orthodontics Department*, Faculty of Dentistry, October 6 University.

Finally my due thanks to all *my young patients and their parents* their part cannot be overlooked.

Dedication

To My parents

for their endless Love and Support.

To my sister

for always being there.

To Miral, Malak and Kenzy

for the happiness they bring into my life.

Content

Introduction	1
Review of Literature	3
Aim of the Study	37
Subjects and Methods	38
Results	59
Discussion	89
Summary	102
Conclusions	104
Recommendations	105
References	106

List of figures

<u>Figure</u>		<u>Page</u>
Figure (1)	Silorane chemistry.	15
Figure (2)	Reactive sites of Silorane and methacrylates and corresponding shrinkage reduction upon polymerization.	15
Figure (3)	Filtek Z250 micro-hybrid resin composite.	41
Figure (4)	Filtek Z350XT nano-filled resin composite.	41
Figure (5)	One-step self-etching adhesive system Adper Easy One Adhesive.	41
Figure (6)	Silorane composite Filtek P90 and P90 Adhesive system.	42
Figure (7)	Diagnostic Chart	46
Figure (8)	The cure cordless TC-CL II light cure, Spring Health Products, Inc., USA	43
Figure (9)	Scanning Electron Microscope (<i>Philips XL 30 attached EDX unit</i>)	49
Figure (10)	Specimens after gold treatment in SEM chamber.	49
Figure (11)	System calibration to a ruler.	51
Figure (12)	Measurement of the length of dye penetration.	51
Figure (13)	Measurement of the whole length of the cavity.	52
Figure (14)	Special Teflon mould.	52
Figure (15)	Primary molar moulded on acrylic block with flat ground occlusal surface.	53
Figure (16)	Primary molars with micro-cylinders of composite.	53
Figure (17)	Micro-shear bond strength testing.	55
Figure (18)	Micro-shear bond strength testing.	55
Figure (19)	Composite cylinders fabricated using a special teflon mould.	57
Figure (20)	Compressive strength testing.	57

Figure (21)	Composite cylinder mounted on a material testing machine.	58
Figure (22)	Gender distribution.	59
Figure (23)	Color match scores of the three tested materials in Class II restorations.	61
Figure (24)	Marginal adaptation scores of the three tested materials in Class II restorations.	62
Figure (25)	Surface roughness scores of the three tested materials in Class II restorations.	63
Figure (26)	Sensitivity scores of the three tested materials in Class II restorations.	64
Figure (27)	Color match scores of the three tested materials in pulpotomy restorations.	66
Figure (28)	Anatomic form scores of the three tested materials in pulpotomy restorations.	67
Figure (29)	Surface roughness scores of the three tested materials in pulpotomy restorations.	68
Figure (30)	Marginal staining scores of the three tested materials in pulpotomy restorations.	69
Figure (31)	Modified USPHS evaluation criteria scores for Class II and pulpotomy restorations after 6 month using Filtek Z250.	70
Figure (32)	Modified USPHS evaluation criteria scores for Class II and pulpotomy restorations after 6 month using Filtek Z350.	71
Figure (33)	Modified USPHS evaluation criteria scores for Class II and pulpotomy restorations after 6 month using Silorane P90.	72
Figure (34)	Class II and pulpotomy restoration using Filtek Z250 during the study period.	73
Figure (35)	Class II and pulpotomy restoration using Filtek Z250 during the study period.	74
Figure (36)	Pulpotomy restoration using Filtek Z250 scoring B for marginal staining during the study period.	75
Figure (37)	Class II and pulpotomy restoration using Filtek Z350 during	76

the study period.

Figure (38)	Class II and pulpotomy restoration using Filtek Z350 during the study period.	77
Figure (39)	Class II & pulpotomy restoration using Filtek Z350 scoring B for color match during the study period.	78
Figure (40)	Class II and pulpotomy restoration using Filtek P90 during the study period.	79
Figure (41)	Class II and pulpotomy restoration using Filtek P90 during the study period.	80
Figure (42)	Class II & pulpotomy restoration using Filtek P90 scoring B for anatomic form during the study period.	81
Figure (43)	SEM representing Filtek Z250 at 600 X magnification.	82
Figure (44)	SEM representing Filtek Z250 at 1200 X magnification.	82
Figure (45)	SEM representing Filtek Z350 at 600 X magnification.	83
Figure (46)	SEM representing Filtek Z350 at 1200 X magnification.	83
Figure (47)	SEM representing Filtek P90 at 600 X magnification.	84
Figure (48)	SEM representing Filtek P90 at 1200 X magnification.	84
Figure (49)	Mean microleakage percentage of the three tested materials.	85
Figure (50)	Microleakage Filtek Z250.	86
Figure (51)	Microleakage Filtek Z350.	86
Figure (52)	Microleakage Filtek P90.	86
Figure (53)	Micro-shear bond strength values of the three tested materials.	87
Figure (54)	Compressive strength values of the three tested materials.	88

List of tables

<u>Table</u>		<u>Page</u>
Table (1)	Distribution of materials used in this study.	40
Table (2)	Modified United States Public Health Service Criteria (USPHS Criteria).	47
Table (3)	Distribution of restorations according to tooth type and procedure done.	60
Table (4)	Frequencies (n) and percentages (%) of color match scores for the three tested materials in Class II restorations throughout the study periods.	61
Table (5)	Frequencies (n) and percentages (%) of marginal adaptation scores for the three tested materials in Class II restorations throughout the study periods.	62
Table (6)	Frequencies (n) and percentages (%) of surface roughness scores for the three tested materials in Class II restorations throughout the study periods.	63
Table (7)	Frequencies (n) and percentages (%) of sensitivity scores for the three tested materials in Class II restorations throughout the study periods.	64
Table (8)	Frequencies (n), percentages (%) of color match scores for the three tested materials in Pulpotomy restorations throughout the study periods.	66
Table (9)	Frequencies (n), percentages (%) of anatomic form scores for the three tested materials in Pulpotomy restorations throughout the study periods.	67
Table (10)	Frequencies (n), percentages (%) of surface roughness scores for the three tested materials in Pulpotomy restorations throughout the study periods.	68
Table (11)	Frequencies (n), percentages (%) of marginal staining scores for the three tested materials in Pulpotomy restorations throughout the study periods.	69
Table (12)	Frequencies (n), percentages (%) for modified USPHS evaluation criteria scores in Class II and pulpotomy restorations after 6 month using Filtek Z250.	70

Table (13)	Frequencies (n), percentages (%) for modified USPHS evaluation criteria scores in Class II and pulpotomy restorations after 6 month using Filtek Z350.	71
Table (14)	Frequencies (n), percentages (%) for modified USPHS evaluation criteria scores in Class II and pulpotomy restorations after 6 month using Silorane P90.	72
Table (15)	The mean and standard deviation (SD) microleakage percentage values for the three tested materials.	85
Table (16)	The mean and standard deviation (SD) micro-shear bond strength values for the three tested materials.	87
Table (17)	The mean and standard deviation (SD) compressive strength values for the three tested materials.	88

Introduction

One of the most significant contributions to dentistry has been the development of resin-based composite technology. Few materials, if any, in the modern history of clinical dentistry have given rise to more investigations and publications than resin composites. The increasing demand for esthetic restorative dentistry and the interest in a conservative approach for conserving sound tooth structure with the potential of tooth reinforcement have contributed to the development and improvements of adhesive techniques and resin composites.

A new category of resin composite was introduced known as low-shrinkage composites. Innovations in this category ranged between modifications performed to the resin matrix (*Weinmann, 2005*) or modifications performed in the filler technology with the introduction of nanofilled composites (*Roeters et al., 2005*).

Guggenberger and Weinmann (2000), described a family of molecules called siloranes, as alternatives to dimethacrylate for dental composite matrices. The name being derived from the combination of siloxanes and oxiranes (epoxies). These molecules polymerize by cationic photo-initiation and produce dental composite with comparable properties and slightly reduced shrinkage compared with Bis-GMA based materials.

Nanotechnology has led to the development of a new composite resin characterized by containing nanoparticles measuring approximately 25 nm and nanoaggregates of approximately 75 nm. It is claimed that restorative composite systems made by the use of nanotechnology can

offer high translucency, high polish, and polish retention similar to those of microfilled, while maintaining physical properties and wear equivalent to several hybrid composites (*Mitra et al., 2003 and Loguercio et al., 2007*).

In recent years, gradual improvements of resin composite materials have been achieved and many clinical investigations have confirmed acceptable restoration performance not only in anterior teeth but also in stress bearing posterior areas. Although in-vitro tests of these materials are essential during their development, the ultimate evaluations should be done in-vivo in a clinical setting with emphasis on relatively short-term studies to provide an early prediction of the long term clinical performance of posterior composites (*Prakki et al., 2004, Rodolpho et al., 2006 and Burke et al., 2011*).

This study is an attempt to evaluate the clinical and in-vitro performance of both nanofilled and silorane composites used in the restoration of primary teeth.

Review of Literature

Dental caries has been and still continues to be among the most commonly occurring dental diseases in the world (*Passi et al., 2007*). The world health organization (WHO) has ranked it as number three among all chronic non-communicable diseases that require attention for prevention and treatment. Moreover, decayed teeth are particularly harmful to children's growth and development and can severely jeopardize their health (*Marthaler, 2004 and Xiao-hong et al., 2008*).

Today's fast life and negligence by parents due to lack of time and low socio-economic status presents an obstacle in access of children to dental care. Thus they seek dental treatment when the caries has progressed far beyond the dentinoenamel junction and is near the pulp or has already resulted in pulpal exposure, indicating the various pulp therapy procedures like pulpotomy or pulpectomy (*McDonald et al., 2004 and Passi et al., 2007*).

For decades, dental amalgam has been the restorative material of choice. It is durable, easy to place and relatively inexpensive. It is tolerant to a wide range of clinical placement conditions and moderately tolerant to the presence of moisture during placement. The durability of amalgam is good-to-excellent in large load-bearing restorations (*Soncini et al., 2007*). Traditionally, restorations in stress-bearing areas on the occlusal surfaces with extensions to one or two proximal surfaces (Class II) have been restored with amalgam giving high rates of success (*Vidneskopperud et al., 2009*). The use of amalgam for pulpotomized teeth has the disadvantage that it does not bond to the tooth structure and does not