



بسم الله الرحمن الرحيم

∞∞∞∞

تم رفع هذه الرسالة بواسطة / حسام الدين محمد مغربي

بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى

مسئولية عن محتوى هذه الرسالة.

ملاحظات : لا يوجد



The Effect of Nanoparticle Addition to a Bioceramic Sealer on its Intra-Tubular Penetration

Submitted thesis to the Endodontic department of the faculty of
Dentistry at Ain Shams University

for

*Partial Fulfillment of the Requirements for
The Master Degree in Endodontics*

By

Nadien Ashraf Thabet

(B.D.S., Nahda University – 2013)

Supervisors

Assoc. Prof. Medhat Taha El Farmawy

*Associate Professor of Endodontics
Faculty of Dentistry, Ain Shams University*

Dr. Sarah Hossam Fahmy

*Lecturer of Endodontics
Faculty of Dentistry, Ain Shams University*

Prof. Dr. Omaila Mohamed Tawfik Kandil

*Professor of Embryo Biotechnology
National Research Centre*

Faculty of dentistry
Ain Shams University

2022

Acknowledgment

*First and foremost, thanks are due to Allah
for without him i can do nothing.*

*I'd like to express my respectful thanks
and profound gratitude to Assoc. Prof.
Medhat Taha El Farmawy, Associate
Professor of Endodontics, Faculty of
Dentistry, Ain Shams University for his
keen guidance, kind supervision.*

*I wish also to express my deepest
gratitude to Dr. Sarah Hossam Fahmy,
Lecturer of Endodontics, Faculty of Dentistry,
Ain Shams University for her guidance,
endless assist and for offering me much of her
time, effort and support throughout the whole
work.*

Nadien Ashraf Thabet

Dedication

This work is dedicated to ...

Words are not sufficient to convey my gratitude to **my loving parents, sisters and brother** to whom I owe everything. Their prayers, unwavering faith and confidence in me has helped me to be the person I am today. I humbly dedicate this work to them.

List of Contents

Title	Page No.
List of Tables	i
List of Figures	ii
List of Abbreviations.....	viii
Introduction	1
Review of Literature	4
Aim of the Study	42
Material and Method	43
Results	59
Discussion	83
Summary	96
Conclusion	98
Recommendations	99
References	101
Arabic Summary	—

List of Tables

Table No.	Title	Page No.
Table (1):	List of materials, instruments and devices.	43
Table (2):	Mean, Standard deviation (SD) values of percentage of intra-tubular dentin sealer penetration for different types of sealers	62
Table (3):	Mean, Standard deviation (SD) values of percentage of intra-tubular dentin sealer penetration for different final irrigation materials.....	66
Table (4):	Mean, Standard deviation (SD) values of percentage of intra-tubular dentin sealer penetration for different irrigation activation methods.....	70

List of Figures

Fig. No.	Title	Page No.
Figure (1):	Photo showing ENDOSEAL MTA sealer.....	45
Figure (2):	Photo showing Titanium Dioxide Nanoparticles.....	45
Figure (3):	Photo showing decoronated roots at 16mm.	47
Figure (4):	Photomicrograph showing the TEM images of the prepared TiO2 nanoparticles and SAED.	50
Figure (5):	Bar chart showing the XRD pattern of the prepared TiO2 nanoparticles.....	51
Figure (6):	Photo showing Rhodamine B dye.....	53
Figure (7):	Photo showing tooth loaded on resin stub.....	53
Figure (8):	Microtome (Buehler).....	54
Figure (9):	Microtome in action.....	54
Figure (10):	Photo showing slide containing root segments (Coronal, Middle, Apical) to be examined.....	55
Figure (11):	Ziess confocal laser scanning microscope.....	56
Figure (12):	Bar chart showing average percentage of intra-tubular dentin sealer penetration for different types of sealers.....	62
Figure (13):	Bar chart showing average percentage of intra-tubular dentin sealer penetration for different final irrigation materials	66

List of Figures (Cont...)

Fig. No.	Title	Page No.
Figure (14):	Bar chart showing average percentage of intra-tubular dentin sealer penetration for different irrigation activation methods.....	70
Figure (15):	Photomicrograph showing <i>CLSM scans of the coronal third of roots irrigated with NaOCL as final flush with CI and obturated with Endoseal MTA without TiO2 nanoparticles.</i>	71
Figure (16):	Photomicrograph showing <i>CLSM scans of the middle third of roots irrigated with NaOCL as final flush with CI and obturated with Endoseal MTA without TiO2 nanoparticles.</i>	71
Figure (17):	Photomicrograph showing CLSM scans of the apical third of roots irrigated with NaOCL as final flush with CI and obturated with Endoseal MTA without TiO2 nanoparticles.	72
Figure (18):	Photomicrograph showing <i>CLSM scans of the coronal third of roots irrigated with NaOCL as final flush with PUI and obturated with Endoseal MTA without TiO2 nanoparticles.</i>	72
Figure (19):	Photomicrograph showing CLSM scans of the middle third of roots irrigated with NaOCL as final flush with PUI and obturated with Endoseal MTA without TiO2 nanoparticles.	73

List of Figures (Cont...)

Fig. No.	Title	Page No.
Figure (20):	Photomicrograph showing CLSM scans of the apical third of roots irrigated with NaOCL as final flush with PUI and obturated with Endoseal MTA without TiO2 nanoparticles.	73
Figure (21):	Photomicrograph showing CLSM scans of the coronal third of roots irrigated with Green tea as final flush with CI and obturated with Endoseal MTA without TiO2 nanoparticles.....	74
Figure (22):	Photomicrograph showing CLSM scans of the middle third of roots irrigated with Green tea as final flush with CI and obturated with Endoseal MTA without TiO2 nanoparticles.....	74
Figure (23):	Photomicrograph showing CLSM scans of the apical third of roots irrigated with Green tea as final flush with CI and obturated with Endoseal MTA without TiO2 nanoparticles.	75
Figure (24):	Photomicrograph showing CLSM scans of the coronal third of roots irrigated with Green tea as final flush with PUI and obturated with Endoseal MTA without TiO2 nanoparticles.....	75
Figure (25):	Photomicrograph showing CLSM scans of the middle third of roots irrigated with Green tea as final flush with PUI and obturated with Endoseal MTA without TiO2 nanoparticles.....	76

List of Figures (Cont...)

Fig. No.	Title	Page No.
Figure (26):	Photomicrograph showing CLSM scans of the apical third of roots irrigated with Green tea as final flush with PUI and obturated with Endoseal MTA without TiO2 nanoparticles.	76
Figure (27):	Photomicrograph showing CLSM scans of the coronal third of roots irrigated with NaOCL as final flush with CI and obturated with Endoseal MTA with TiO2 nanoparticles.	77
Figure (28):	Photomicrograph showing CLSM scans of the middle third of roots irrigated with NaOCL as final flush with CI and obturated with Endoseal MTA with TiO2 nanoparticles.	77
Figure (29):	Photomicrograph showing CLSM scans of the apical third of roots irrigated with NaOCL as final flush with CI and obturated with Endoseal MTA with TiO2 nanoparticles.	78
Figure (30):	Photomicrograph showing CLSM scans of the coronal third of roots irrigated with NaOCL as final flush with PUI and obturated with Endoseal MTA with TiO2 nanoparticles.	78
Figure (31):	Photomicrograph showing CLSM scans of the middle third of roots irrigated with NaOCL as final flush with PUI and obturated with Endoseal MTA with TiO2 nanoparticles.	79

List of Figures (Cont...)

Fig. No.	Title	Page No.
Figure (32):	Photomicrograph showing CLSM scans of the apical third of roots irrigated with NaOCL as final flush with PUI and obturated with Endoseal MTA with TiO2 nanoparticles.	79
Figure (33):	Photomicrograph showing CLSM scans of the coronal third of roots irrigated with Green tea as final flush with CI and obturated with Endoseal MTA with TiO2 nanoparticles.	80
Figure (34):	Photomicrograph showing CLSM scans of the middle third of roots irrigated with Green tea as final flush with CI and obturated with Endoseal MTA with TiO2 nanoparticles.	80
Figure (35):	Photomicrograph showing CLSM scans of the apical third of roots irrigated with Green tea as final flush with CI and obturated with Endoseal MTA with TiO2 nanoparticles.	81
Figure (36):	Photomicrograph showing CLSM scans of the coronal third of roots irrigated with Green tea as final flush with PUI and obturated with Endoseal MTA with TiO2 nanoparticles.	81

List of Figures (Cont...)

Fig. No.	Title	Page No.
Figure (37):	Photomicrograph showing CLSM scans of the middle third of roots irrigated with Green tea as final flush with PUI and obturated with Endoseal MTA with TiO2 nanoparticles.	82
Figure (38):	Photomicrograph showing CLSM scans of the apical third of roots irrigated with Green tea as final flush with PUI and obturated with Endoseal MTA with TiO2 nanoparticles.	82

List of Abbreviations

Abb.	Full term
<i>BDA</i>	<i>Bis-dequalinium acetate</i>
<i>CA</i>	<i>citric acid</i>
<i>CEJ</i>	<i>cementoenamel junction</i>
<i>C-HA</i>	<i>Chitosan-Hydroxyapatite precursor</i>
<i>CHX</i>	<i>Chlorhexidine</i>
<i>CLSM</i>	<i>Confocal laser scanning microscope</i>
<i>EA</i>	<i>EndoActivator</i>
<i>EAW</i>	<i>Electronically activated water</i>
<i>EC</i>	<i>Easy Clean</i>
<i>EDS</i>	<i>energy-dispersive x-ray spectroscopy</i>
<i>EDTA</i>	<i>Ethylenediaminetetraacetic acid</i>
<i>Er:YAG</i>	<i>Erbium:yttrium-aluminum-garnet</i>
<i>ES</i>	<i>Endo Spray</i>
<i>EV</i>	<i>EndoVac</i>
<i>GF Bioseal</i>	<i>Guttaflow bioseal</i>
<i>H2O2</i>	<i>Hydrogen peroxide</i>
<i>HEBP</i>	<i>etidronic acid</i>
<i>HRS</i>	<i>Hybrid root seal</i>
<i>LAI</i>	<i>Laser-activated irrigation</i>
<i>LS</i>	<i>Lentulo spiral</i>
<i>MA</i>	<i>maleic acid</i>
<i>MTA</i>	<i>Mineral trioxide aggregate</i>
<i>NaOCl</i>	<i>Sodium hypochlorite</i>
<i>Nd:YAG</i>	<i>Neodymium-doped:yttrium-aluminum-garnet</i>
<i>NT</i>	<i>Syringe and NaveTip needle</i>
<i>NTS</i>	<i>Novel tricalcium silicate-based sealer</i>
<i>PAA</i>	<i>peracetic acid</i>
<i>PAD</i>	<i>Photo-activated disinfection</i>
<i>PBS</i>	<i>phosphate buffer solution</i>

List of Abbreviations (Cont...)

Abb.	Full term
<i>PCS</i>	<i>Zinc oxide based Pulp Canal sealer</i>
<i>PIPS</i>	<i>Photon-induced-photoacoustic streaming activation</i>
<i>PUI</i>	<i>Passive ultrasonic irrigation</i>
<i>Pz-</i>	<i>pozzolan-based</i>
<i>SAF</i>	<i>Self-Adjusting File</i>
<i>SEM</i>	<i>Scanning electron microscopy</i>
<i>SI</i>	<i>Sonic irrigation</i>
<i>TCS</i>	<i>tricalcium silicate sealer</i>
<i>TiO₂</i>	<i>Titaniumdioxide</i>
<i>UTS</i>	<i>ultimate tensile strength</i>
<i>ZOE</i>	<i>Zinc Oxide Eugenol</i>

INTRODUCTION

The main goal of root canal treatment is to provide a three-dimensional obturation of the root canal system. A hermetic seal reduces coronal leakage and bacterial contamination, prevents apical periodontitis, and entombs the remaining irritants in the root canal. Various endodontic materials have been developed for complete and impermeable fillings. Root canal sealers are necessary to seal the gap between the root dentin wall and the obturating material. Sealers should seal the root canal apically and laterally, and also fill voids and irregularities. The ability of the sealer to penetrate into the dentinal tubules is important, as this helps the sealer provide a fluid-tight seal and prevent penetration by microorganisms and toxins⁽⁵⁵⁾.

Due to the relative biological and technical importance of sealers, their chemical and physical properties have been the subject of considerable attention since their initial development in the early twentieth century. Sealers are categorised according to their main chemical constituents: zinc oxide eugenol, calcium hydroxide, glass ionomer, silicone, resin, and bioceramic-based sealers.

Bioceramic-based sealers have only been available for use in endodontics for the past thirty years, their rise to prominence corresponding to the increased use of bioceramic technology in the fields of medicine and dentistry.