



EVALUATION OF HESPERIDIN [FLAVONOID] AS A DIRECT PULP CAPPING MATERIAL

A Thesis

Submitted to the Faculty of Dentistry, Ain Shams University,
in Partial Fulfillment of Requirements of Doctor's Degree
in **Endodontics**

By

Ebtesam Osama Hassan Abo El-Mal

**B.D.S Misr University for Science and Technology (MUST)
M.Sc. in Endodontics Cairo University**

**Faculty of Dentistry,
Ain Shams University
2017**

SUPERVISORS

Prof. Dr.

Salma Hassan El-Ashry

Professor of Endodontics
Endodontics Department
Faculty of Dentistry
Ain Shams University

Prof. Dr.

Ashraf Mohamed Abdel-Rahman Abu-Seida

Professor of Surgery, Anesthesiology & Radiology
Department of Surgery, Anesthesiology & Radiology
Faculty of Veterinary Medicine
Cairo University



تقييم الهسبردين [فلافيويد] كتغطية مباشرة للـب الأسنان

رسالة

مقدمة لكلية طب الأسنان - جامعة عين شمس
توطئة لاستكمال المتطلبات للحصول على درجة الدكتوراه في
علاج الجذور

مقدمة من

الطبيبة / إبتسام أسامة حسن أبو المال

بكالوريوس طب وجراحة الأسنان، جامعة مصر للعلوم والتكنولوجيا
ماجستير علاج الجذور كلية طب الفم والأسنان، جامعة القاهرة

كلية طب الأسنان

جامعة عين شمس

2017

المشرفون

أ.د./ سلمى حسن العشرى

أستاذ بقسم علاج الجذور

كلية طب الأسنان

جامعة عين شمس

أ.د. أشرف محمد عبد الرحمن أبو سعدة

أستاذ بقسم الجراحة والتخدير والأشعة

كلية الطب البيطرى

جامعة القاهرة

Dedication

*To my loving father, mother, my brother's family
who always have confidence in me,
and give me unconditional support and love,
and to my little heart and adorable smile
Malek.*

Acknowledgement

First of all thank GOD for being by my side to finish my work,

*Many people deserve my sincere thanks for the integral roles they played in making this dissertation possible. I must thank my role model **Prof. Dr. Salma Hassan El-Ashry**, for her relentless encouragement and endless support during many years of guidance and research collaboration. Her insight advice and theoretical vision inspired and improved this work in countless ways.*

*I would also like to thank **Prof. Dr. Ashraf Abdel-Rahman Abu Seida** for the support and opportunities for working in the Faculty of Veterinary Medicine, Cairo University.*

*I am deeply grateful to my idol **Prof. Dr. Amal Hassan Abd El-Rahman** – Professor of Oral Pathology, Vice-Dean Faculty of Dentistry, ACU University- who was always there when I needed either academic and/or personal advice or help.*

*Special thanks to **Prof. Dr. Dalia El-Roby** for helping me in the statistics for the study, and thankfulness must extend to **Dr. Mohamed Mokhtar** for his valuable help.*

*My sincere gratitude to my lovely friend and sister **Marwa Hamada** and my colleagues **Mohamed Sami, Walaa Samir** and **Mona Kamal** for their help and sincere efforts.*

I am also very grateful to my friends, colleagues at MUST and family for the unwavering support and patience they have granted while I have been finishing my dissertation.

Elteram Orama Abo El-Mal

LIST OF CONTENTS

INTRODUCTION	1
REVIEW OF LITERATURE	3
I] Physical properties of pulp capping materials	5
II] Pulp capping procedures	13
AIM OF THE STUDY	38
MATERIALS AND METHODS	39
Materials	39
<i>Part I: Evaluation of some physical properties of</i> <i>Hesperidine powder and MTA-Angelus</i>	41
<i>Part II: Histological analysis of dogs dental pulp tissue</i> <i>capped with the materials</i>	54
Statistical Analysis	64
RESULTS	65
I] Physical properties of the materials	65
II] Histological analysis of dogs dental pulp tissue capped with the materials	76
DISCUSSION	113
SUMMARY & CONCLUSIONS	126
RECOMMENDATIONS	130
BIBLIOGRAPHY	131
ARABIC SUMMARY	-

LIST OF TABLES

Table No.	Table	Page
1	Tested materials and their composition according to the manufacturers.....	40
2	Mean values of initial and final setting time and comparison between groups (ANOVA test).....	66
3	Comparing initial and final setting times in each group	67
4	Mean values of radiopacity and comparison between groups (ANOVA test).....	69
5	Mean values of percentage of mass change and comparison between groups (ANOVA test).....	71
6	Mean values of different pH and comparison within the same group (ANOVA test)	73
7	Mean values of pH at different evaluation periods between groups (ANOVA test)	75
8	Inflammatory score between different subgroups at the same observation period (Chi square test).....	85
9	Inflammatory score between different time intervals within the same subgroup (Chi square test).....	87
10	Hard tissue (dentinal bridge) and histological features grades in 2 weeks (Group I), and significance of difference between subgroups (Chi square test).....	90
11	Hard tissue (dentinal bridge) and histological features in 4 weeks (Group II), and significance of difference between subgroups (Chi square test)	94
12	Hard tissue (dentinal bridge) and histological features in 8 weeks (Group III), and significance of difference between subgroups (Chi square test)	100

Table No.	Table	Page
13	Hard tissue (dental bridge) and histological features of Hesperidin (subgroup A), and significance within different observation periods (Chi square test)	107
14	Hard tissue (dental bridge) and histological features of MTA (subgroup B), and significance within different observation periods (Chi square test)	109
15	Hard tissue (dental bridge) and histological features of Dycal (subgroup C), and significance within different observation periods (Chi square test)	111

LIST OF FIGURES

Fig. No.	Figure	Page
1	Classification of samples evaluating the physical properties	42
2	Ring mold used for determination of the setting time	45
3a	Gillmore needle for determination of initial setting time	45
3b	Gillmore needle for determination of final setting time ..	45
4	Acrylic plate used for radiopacity	46
5	The assembly of the acrylic plates with the tested materials (yellow arrow) and aluminum step-wedge (black arrow) in front of the digital phosphor plate (blue arrow)	49
6	Acrylic device for positioning the phosphor plate at standardized object-to-focus distance.....	49
7	Ring molds used for determination of solubility	52
8	Discs of capping materials hung in distilled water to measure solubility	52
9	Classification of samples evaluating histopathological response	57
10	Column chart showing mean values of initial and final setting times in different groups	66
11	Column chart showing mean values of initial and final setting times in each group	67
12	Column chart showing mean values of radio-opacity in different groups.....	69

Fig. No.	Figure	Page
13	Column chart showing mean values of % of mass change in different groups	71
14	Column chart showing mean values at different pH evaluation period within the same group.....	74
15	Column chart showing mean pH values of different groups at each evaluation period	75
16	H&E Photomicrograph of Gp IA showing moderate inflammation localized directly beneath the exposure site.....	77
17	Higher magnification to the previous figure of Gp IA showing moderate inflammation scattered to some extent in the pulp tissue	77
18	H&E Photomicrograph showing mild inflammatory infiltrate, focal necrotic areas (blue arrow) around the exposure site and a massive vascular dilatation (yellow arrow) in non-necrotic areas	78
19	H&E photomicrograph of Gp IB showing moderate inflammation localized directly beneath the exposure site.....	78
20	H&E photomicrograph of Gp IB showing moderate inflammation scattered to some extent in the pulp tissue	79
21	H&E photomicrograph of Gp IC showing severe inflammation directly beneath the exposure site.....	79
22a	H&E photomicrograph of Gp IC showing severe inflammation scattered in the pulp tissue	80

Fig. No.	Figure	Page
22b	Higher magnification of the previous figure of Gp IC showing severe peri-vascular inflammation in the pulp tissue	80
23	H&E photomicrograph of Gp IIA showing mild amount of scattered chronic inflammatory cells in the pulp with disappearance of most of the focal necrotic areas and vascular dilatation.....	81
24	H&E photomicrograph of Gp IIB showing persistence of moderate amount of inflammatory infiltrate and partially healed necrotic areas	82
25	H&E photomicrograph of Gp IIC showing persistence of moderate amount of inflammatory infiltrate with micro abscess formation	82
26	H&E photomicrograph of Gp IIIA showing mild inflammatory cell infiltration in the coronal pulp	83
27	H&E photomicrograph of Gp IIIB showing mild inflammatory cell infiltration in the coronal pulp with focal necrotic areas	84
28	H&E photomicrograph of Gp IIIC showing moderate inflammatory cell infiltration in the coronal pulp with focal necrotic areas	84
29	Column chart showing percentage of inflammatory scores in different groups	86
30	Column chart showing the effect of time on inflammatory scores in each subgroup according to the percentages of samples	88
31	Column chart showing hard tissue (dentinal bridge) features of different subgroups in 2 weeks.....	91

Fig. No.	Figure	Page
32	Column chart showing histological features of different subgroups in 2 weeks	91
33	H&E photomicrograph of Gp IB showing no calcific bridge formation	92
34	H&E photomicrograph of Gp IA showing material pushed in the pulp space (yellow arrow) with dystrophic calcification around (blue arrow).....	92
35	Column chart showing the hard tissue (dental bridge) features of different subgroups in 4 weeks	95
36	Column chart showing the histological features of different subgroups in 4 weeks	95
37	H&E photomicrograph of Gp IIA showing a dense moderately thick structure of an amorphous, non-tubular interrupted material (yellow arrows) with scattered calcified deposits (blue arrows).....	96
38	H&E photomicrograph of Gp IIA showing cellular inclusions similar to that of lacunae found in the bone ...	96
39	H&E photomicrograph of Gp IIB showing thin structure of an amorphous and non-tubular interrupted material	97
40	H&E photomicrograph of Gp IIB, the arrow showing the extension between old and new calcific bridge. Note the space occupied with atubular dentin.....	97
41	H&E photomicrograph of Gp IIB showing disorganized interrupted odontoblastic layer (blue arrow). Note the interrupted atubular dentin layer (yellow arrow).....	98

Fig. No.	Figure	Page
42	H&E Photomicrograph of Gp IIC showing a very narrow interrupted zone of condensed hard deposit.....	98
43	Column chart showing the hard tissue (dental bridge) features of different subgroups in 8 weeks	101
44	Column chart showing the histological features of different subgroups in 8 weeks	101
45a	H&E photomicrograph of Gp IIIA showing dentine bridge formation with a recognizable continuous thick thickness	102
45b	Higher magnification of the previous figure of Gp IIIA showing dentine bridge formation with a recognizable thick thickness	102
46a	H&E photomicrograph of Gp IIIA showing a hyperplastic dis-organized odontoblast-like cell layer with tubular dentin, complete resolution of necrosis and normal vascularity.....	103
46b	Higher magnification of the previous figure showing tubular dentin (yellow arrow) and hyperplasia of odontoblast-like cell layer (blue arrow).....	103
47a	H&E Photomicrograph of Gp IIIB showing randomly organized odontoblast-like cell layer with irregular tubular dentin	104
47b	Higher magnification of the previous figure of Gp IIIB showing randomly organized odontoblast-like cell layer (blue arrow) with irregular tubular dentin (yellow arrow)	104
48	H&E photomicrograph of Gp IIIC showing wide interrupted zone of condensed hard deposit	105

Fig. No.	Figure	Page
49	Column chart showing the hard tissue (dental bridge) features of Hesperidin within different observation periods.....	108
50	Column chart showing the histological features of Hesperidin within different observation periods	108
51	Column chart showing the hard tissue (dental bridge) features of MTA within different observation periods.....	110
52	Column chart showing the histological features of MTA within different observation periods.....	110
53	Column chart showing the hard tissue (dental bridge) features of Dycal within different observation periods.....	112
54	Column chart showing the histological features of MTA within different observation periods.....	112