

Mona maghraby

بسم الله الرحمن الرحيم

مركز الشبكات وتكنولوجيا المعلومات قسم التوثيق الإلكتروني







Mona maghraby

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها على هذه الأقراص المدمجة قد أعدت دون أية تغيرات





Mona maghraby





بعض الوثائق الأصلية تالفة وبالرسالة صفحات لم ترد بالأصل



Cue , sus many (Le) Lay, by of the Charles of the

BINNE

Evaluation of Occlusal Stresses on Post Crown Restorations using the Finite Element Stress Analysis

Thesis

submitted to the Faculty of Dentistry
University of Alexandria
in partial fulfilment of the requirements
for the Masters Degree in
Restorative Dentistry

by

Naguib Ahmad Naguib El-Fawal B.D.S.

Faculty of Dentistry University of Alexandria

Supervisors

Prof. Dr. Abd El-Rahman Wasfy

Dean of the Faculty of Dentistry Professor of Restorative Dentistry Faculty of Dentistry University of Alexandria

Prof. Dr. Mahmoud A. Helmy

Professor of Structural Engineering Faculty of Engineering University of Alexandria

Dr. Hamdy A. M. Osman
Associate Professor of Restorative Dentistry
Faculty of Dentistry
University of Alexandria

Dedicated to:

The memory of my Father,

my Mother,

my fiancé,

and my family....

Acknowledgment

This thesis grew out of combined effort and support; and my approach has been greatly influenced by my professors, colleagues, friends and family.

I wish to express my greatest thanks and appreciation to **Professor Abd EI-Rahman Wasfy,**Professor of Restorative Dentistry and Dean of the Faculty of

Dentistry, University of Alexandria, whose untiring support and care are the

foundation on which I pursue my academic aspirations and achievements. I

greatly appreciate his patience, understanding and knowledge, despite his great

responsibilities.

To **Professor Dr. Mahmoud Helmy,**Professor of Structural Engineering, Faculty of Engineering, University of Alexandria, who made research work an exciting and a stimulating one. I owe my greatest measure of gratitude and appreciation. I thank him very much for his precious time, careful help and constructive criticism that he willingly and constantly gave. I, also, appreciate the enthusiasm and pride he has infused into my work.

It is a great pleasure to express my thanks to **Associate Professor**, **Dr**. **Hamdy Osman**, Restorative Dentistry Department, Faculty of Denstistry, University of Alexandria, for his constant encouragement, support, and invaluable suggestions and guidance over the years. I appreciate his kindness and unlimited help.

Also I would like to acknowledge the contributions and efforts in the computer work of Engineer Mohammed Salah El-Deenwithout whom this

work would never have been completed under the guidance of Professor Dr.

Mahmoud Helmy. I deeply thank him and greatly appreciate his honest help.

I would like to extend my appreciation to **Dr. Hamdy Kandeel**, Faculty of Engineering, University of Alexandria, and to his wife, **Dr. Hoda Youssef**, Faculty of Medicine, University of Alexandria, for their great effort and excellent work, which have contributed significantly to the completion of this thesis.

Special acknowledgment to **Mrs. Gayle Zahran**, who has patiently and skillfully participated in the finishing up of my thesis. I thank her for her kindness, exceptional work and invaluable effort.

My deepest appreciation and gratitude go to my parents, who have inspired me to strive towards excellence in dentistry and education and who have set a lively and true example of idealism and perfection. I owe them for their lifelong support, love and encouragement.

To my fiancé, **Dr. Amal Turky**, who has earned my utmost respect for her energy and commitment and whose patience and kind understanding made everything worthwhile. I express my greatest gratitude and appreciation.

Last, but not least, my deepest thanks go to **Professor Dr. Abd El-Aziz Fayed,** Chairman of the Restorative Dentistry department, Faculty of Dentistry,

University of Alexandria, and all the department staff for their encouragement and

helpful advice and, not to be forgotten, to the many colleagues, friends and

dental students over the years.

Table of Contents

	Page
INTRODUCTION	1
REVIEW OF LITERATURE	6
I Historical Review	6
II Definitions	10
III Types of Post-retained Crowns	17
IV Endodontic Posts	17
A. Indications and Contraindications of Endodontic Posts	17
B. Functions of Endodontic Posts	19
C. Requirements of Endodontic Posts	19
D. Classification of Endodontic Posts	22
E. Variables of Endodontic Posts	28
1. Post Diameter	28
2. Post Length	31
3. Post Taper	33
4. Post Direction	35
F. Stresses and the Endodontic Post	36
V Methods of Stress Analysis	39
A. Experimental Methods of Stress Analysis	40
B. Theoretical (Numerical) Methods of Stress Analysis	43
VI Stress Analysis of Endodontic Posts	48
A. Strain Gauge Method	48
B. Photoelastic Stress Analysis Method	49
C. Finite Element Stress Analysis Method	61
AIM OF THE WORK	60

MATERIALS AND METHODS	69
A. Posts used	69
B. Development of finite elem	
C. Running the computer prog	gram 94
RESULTS A. Introduction	95 95
 B. Stress patterns of the three designs (mesially or distally 	
 C. Stress patterns of the three post designs (palatally) in X 	e diameters of the three K, Y and Z directions
 D. Stress Patterns of the three post designs (labially) in X, 	
E. Comparison between the state three post designs of the d	
 F. Comparison between the s three post designs of the d 	tress patterns of the ameter 1.25 mm.
G. Comparison between the sthree post designs of the comparison.	
H. Comparison of the maxim the three diameters of the different surfaces in X, Y	three post designs at
I. Comparison of the maximum three diameters of the three different locations in X, Y	ee post designs at
 J. Comparison between the of the three diameters of the and the compressive - ten 	he three post designs
DISCUSSION	211
SUMMARY AND CONCLUSIO	N 228
REFERENCES	234
PROTOCOL	
ARABIC SUMMARY	

List of Figures

		Pages
1	Analogy for lack of ferrule effect is to split a log with a metal wedge	12
2	Ferrule effect prevents log from being split	12
3	Types of stresses found in structures subjected to the influence of external forces	23
4	Classification of endodontic post	23
5	The philosophies of dowel diameter preparation	29
6	Lever arm for a short post	34
7	Lever arm for a long post	34
8	Circular polariscope arrangement	42
9	Finite element models of the three post designs	70
10	Parallel-sided custom-cast post and core a. Labial view b. Proximal view	71
11	a. Flexi-Post system b. Flexi-Post post	73
12	a. Para-Post System b. Para-Post post	76
13	Complete finite element model incorporating parallel-sided Custom-Cast post	
	a. Labial view b. Mesial view	80 81
14	Complete finite element model incorporating Flexi-Post post a. Labial view b. Mesial view	82 83
15	Complete finite element model incorporating Para-Post post a. Labial view	
	b. Mesial view	84 85
16	The magnitude and direction of the applied load	93

17A Stress patterns of the three diameters of Cast post mesially or distally in Y-direction	97
17B Stress patterns of the three diameters of Cast Post mesially or distally in X-direction	97
17C Stress patterns of the three diameters of Cast post mesially or distally in Z-vertical direction	105
18A Internal stresses in X-X direction at the dentine wall for Cast Post of diameter 1.00 mm.	948
18B Internal stresses in X-X direction at the dentine wall for Cast Post of diameter 1.25 mm.	99
18C Internal stresses in X-X direction at the dentine wall for Cast Post of diameter 1.50 mm.	100
19A Internal stresses in Y-Y direction at the dentine wall for Cast Post of diameter 1.00 mm.	102
19B Internal stresses in Y-Y direction at the dentine wall for Cast Post of diameter 1.25 mm.	103
19C Internal stresses in Y-Y direction at the dentine wall for Cast Post of diameter 1.50 mm.	104
20A Internal stress in Z-Z direction at the dentine wall for Cast Post of diameter 1.00 mm.	106
20B Internal stress in Z-Z direction at the dentine wall for Cast Post of diameter 1.25 mm.	107
20C Internal stress in Z-Z direction at the dentine wall for Cast Post of diameter 1.50 mm.	108
21A Stress patterns of the three diameters of Flexi-Post mesially or distally in Y-direction	109
21B Stress patterns of the three diameters of Flexi-Post mesially or distally in X-direction	
21C Stress patterns of the three diameters of Flexi-Post mesially or distally in Z-vertical direction	109
22A Internal stress in X-X direction at the dentine wall for model with Flexi-Post of diameter 1.00 mm.	117
22B Internal stress in X-X direction at the dentine wall for model	110
with Flexi-Post of diameter 1.25 mm.	111

220	Internal stress in X-X direction at the dentine wall for model with Flexi-Post of diameter 1.50 mm.	112
23A	Internal stresses in Y-Y direction at the dentine wall for model with Flexi-Post of diameter 1.00 mm.	114
23E	Internal stresses in Y-Y direction at the dentine wall for model with Flexi-Post of diameter 1.25 mm.	115
230	Internal stresses in Y-Y direction at the dentine wall for model with Flexi-Post of diameter 1.50 mm.	116
24A	Internal stresses in Z-Z direction at the dentine wall for model with Flexi-Post of diameter 1.00 mm.	118
24B	Internal stresses in Z-Z direction at the dentine wall for model with Flexi-Post of diameter 1.25 mm.	119
24C	Internal stresses in Z-Z direction at the dentine wall for model with Flexi-Post of diameter 1.50 mm.	120
25A	Stress patterns of the three diameters of Para-Post mesially or distally in Y-direction	121
25B	Stress patterns of the three diameters of Para-Post mesially or distally in X-direction	121
25C	Stress patterns of the three diameters of Para-Post mesially or distally in Z-vertical direction	129
26A	Internal stresses in X-X direction at the dentine wall for model with Para-Post of diameter 1.00 mm.	122
26B	Internal stresses in X-X direction at the dentine wall for model with Para-Post of diameter 1.25 mm.	123
26C	Internal stresses in X-X direction at the dentine wall for model with Para-Post of diameter 1.50 mm.	124
	Internal stresses in Y-Y direction at the dentine wall for model with Para-Post of diameter 1.00 mm.	125
	Internal stresses in Y-Y direction at the dentine wall for model with Para-Post of diameter 1.25 mm.	126
	Internal stresses in Y-Y direction at the dentine wall for model with Para-Post of diameter 1.50 mm.	127

28	A Internal stresses in Z-Z direction at the dentine wall for mode with Para-Post of diameter 1.00 mm.	130
28	B Internal stresses in Z-Z direction at the dentine wall for mode with Para-Post of diameter 1.25 mm.	I 131
28	C Internal stresses in Z-Z direction at the dentine wall for mode with Para-Post of diameter 1.50 mm.	132
29	A Stress patterns of the three diameters of Cast Post palatally in Y-direction	133
291	3 Stress patterns of the three diameters of Cast Post palatally in X-direction	133
290	Stress patterns of the three diameters of Cast Post palatally in Z-vertical direction	134
30/	A Stress patterns of the three diameters of Flexi-Post palatally in Y-direction	136
30E	3 Stress patterns of the three diameters of Flexi-Post palatally in X-direction	136
300	Stress patterns of the three diameters of Flexi-Post palatally in Z-vertical direction	137
31A	Stress patterns of the three diameters of Para-Post palatally in Y-direction	138
31B	Stress patterns of the three diameters of Para-Post palatally in X-direction	138
31C	Stress patterns of the three diameters of Para-Post palatally in Z-vertical direction	139
32A	Stress patterns of the three diameters of Cast Post labially in Y-direction	140
32B	Stress patterns of the three diameters of Cast Post labially in X-direction	140
32C	Stress patterns of the three diameters of Cast Post labially in Z-vertical direction	142
33A	Stress patterns of the three diameters of Flexi-Post labially in Y- direction	143
33B	Stress patterns of the three diameters of Flexi-Post labially in X- direction	
		143

33C	Stress patterns of the three diameters of Flexi-Post labially in Z- vertical direction	144
34A	Stress patterns of the three diameters of Para-Post labially in Y- direction	145
34B	Stress patterns of the three diameters of Para-Post labially in X- direction	145
34C	Stress patterns of the three diameters of Para-Post labially in Z- vertical direction	146
35A	Stress patterns of the three post designs for D=1.00 mm.mesially or distally in Y-direction	152
35B	Stress patterns of the three post designs for D=1.00 mm. mesially or distally in X-direction	152
35C	Stress patterns of the three post designs for D=1.00 mm. mesially or distally in Z-vertical direction	153
36A	Stress patterns of the three post designs for D=1.00 mm. palatally in Y-direction.	154
36B	Stress patterns of the three post designs for D=1.00 mm. palatally in X-direction.	154
36C	Stress patterns of the three post designs for D=1.00 mm. palatally in Z-vertical direction.	155
37A	Stress patterns of the three post designs for D=1.00 mm. labially in Y-direction	157
37B	Stress patterns of the three post designs for D=1.00 mm. labially in X-direction	157
37C	Stress patterns of the three post designs for D=1.00 mm. labially in Z-vertical direction	158
38A	Stress patterns of the three post designs for D=1.25 mm mesially or distally in Y-direction	160
	Stress patterns of the three post designs for D=1.25 mm mesially or distally in X-direction	160
	Stress patterns of the three post designs for D=1.25 mm mesially or distally in Z-vertical direction	161