

**EFFECT OF FERRULE HEIGHT AND GLASS FIBRE POST
LENGTH ON FRACTURE RESISTANCE OF
ENDODONTICALLY TREATED TEETH**

SHUROOQ SH ABDULRAZZAK

**DISSERTATION SUBMITTED IN FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
MASTER OF DENTAL SCIENCE**

**DEPARTMENT OF CONSERVATIVE DENTISTRY
FACULTY OF DENTISTRY, UNIVERSITY OF MALAYA
KUALA LUMPUR**

2011

ABSTRACT

Objectives: 1. To evaluate the effect of ferrule height (FH) and post length (PL) on fracture resistance of endodontically treated teeth (ETT) restored with glass fibre post, composite resin core and crown. 2. To assess the effect of FH and PL on the failure mode of these teeth.

Methods: Ninety endodontically treated maxillary central incisors were randomly divided into three groups of 30 according to their FH: 4, 2 and 0 mm. Post space was prepared according 2/3, 1/2 and 1/3 of the root length (N = 10 each). RelyX™ fibre posts (3M/ESPE, USA) were then cemented with self adhesive resin cement (RelyX™ Unicem, 3M/ESPE, USA). Core build-ups were done using composite resin (Filtek™ Z350, 3M/ESPE, USA). Cast metal crowns were cemented on the prepared specimens using RelyX Unicem. The specimens were thermocycled and compressive static load was applied at an angle of 135 degrees to the crown. The load (N) at failure and mode of failure were recorded. Statistical analysis was performed with Two-way ANOVA.

Results: No significant interaction between ferrule heights and post lengths was observed ($p = 0.801$). Significant difference in the failure load was found in the ferrule height groups ($p < 0.001$) but not in the post length groups ($p = 0.102$). 4 mm ferrule group had significantly higher failure load (FL) ($536.7 \text{ N} \pm 195.4$) compared to 2 mm ($414.6 \text{ N} \pm 133$) and 0 mm ferrule groups ($319.8 \text{ N} \pm 54.7$) ($p = 0.018, p < 0.001$). 2 mm ferrule group had significantly higher FL than 0 mm ferrule group ($p = 0.002$). More favourable failure modes were observed in almost all subgroups.

Conclusion: Increasing the FH significantly increased the fracture resistance of ETT restored with glass fibre post, composite resin core and a crown. Post length had no significant effect on the fracture resistance. Most groups had favourable failure mode.

UNIVERSITI MALAYA
ORIGINAL LITERARY WORK DECLARATION

Name of Candidate: Shurooq Sh. Abdulrazzak

Registration/Matric No: DGC080007

Name of Degree: Master of Dental Sciences

Title of Project Paper/Research Report/Dissertation/Thesis (“this Work”):

Effect of ferrule height and glass fibre post length on fracture resistance of endodontically treated teeth.

Field of Study: Conservative Dentistry

I do solemnly and sincerely declare that:

- (1) I am the sole author/ writer of this Work;
- (2) This Work is original;
- (3) Any use of any work in which copyright exists was done by way of fair dealing and for permitted purposes and any except or extract from, or reference to or reproduction of any copyright work has been disclosed expressly and sufficiently and the title of the Work and its authorship have been acknowledged in this Work;
- (4) I do not have any actual knowledge nor ought I reasonably to know that the making of this Work constitutes an infringement of any copyright work;
- (5) I hereby assign all and every rights in the copyright to this Work to the University of Malaya “UM”, who henceforth shall be owner of the copyright in this Work and that any reproduction or use in any form or by any means whatsoever is prohibited without the written consent of UM having been first had and obtained;
- (6) I am fully aware that if in the course of making this Work I have infringed any copyright whether intentionally or otherwise, I may be subject to legal action or any other action as may be determined by University of Malaya.

Candidate’s Signature

Date:

Subscribed and solemnly declared before,

Witness’s Signature/ Supervisor

Date:

Name: Eshamsul Bin Sulaiman

Designation: Senior lecturer

ACKNOWLEDGMENTS

First, All Praise to ALLAH, for giving me the strength and patience for doing this study.

I would like to express my sincere thanks to my supervisor Dr. Eshamsul Sulaiman for his support, insight, guidance and encouragement throughout the preparation of this dissertation. I will never forget his kindness.

I also would like to thank other members of my examination committee for reading the thesis.

I would like to extend my heartfelt thanks to the support and guidance of Prof. Dr. Noorhayati Abu Kasim the head of conservative Department.

I would like to thank the Dean of the Faculty of Dentistry, Professor Dato' Dr. Ishak Abdul Razak for his help in making this research possible.

A special thanks to Dr. Marhazlinda Jamaludin, who is most responsible in helping me through the statistical part of this study.

Lastly, a special word of thanks goes to my parents and my husband for their never ending support, love and encouragement that has eased the way not only during the completion of this thesis but throughout my whole life.

CONTENTS

Title page	i
Abstract	ii
Declaration	iii
Acknowledgment	iv
Table of content	v
List of figures	x
List of tables	xii
CHAPTER ONE: INTRODUCTION, AIM AND OBJECTIVES	1
1.1 Introduction	2
1.2 Aim	3
1.3 Objectives	3
CHAPTER TWO: LITERATURE REVIEW	4
2.1 Survival rate of endodontically treated teeth	5
2.2 Remaining coronal tooth structure	6
2.3 Ferrule effect	9
2.4 Post	11
2.4.1 Indication	11
2.4.2 Classification	12
2.4.2.(a) active posts	12
2.4.2.(b) Passive posts	13
2.4.3 Material	13
2.4.3.(a) Tooth-coloured posts	13
2.4.3.(a).(i) Fibre reinforced composite posts	13

2.4.3.(a).(ii) Ceramic and Zirconium Posts	17
2.4.3.(b) Metallic posts	18
2.4.4 Post length	19
2.4.5 Post diameter	20
2.4.6 Post design	21
2.5 Luting cements	25
2.5.1 Luting agents	26
2.5.1.(a) Resin luting cements	26
2.5.1.(a).(i) Composition	26
2.5.1.(a).(ii) Physical and mechanical properties	27
2.5.1.(a).(iii) Adhesion	28
2.5.1.(a).(iv) Disadvantages	28
2.5.1.(a).(v) Classification of resin luting cements	28
2.6 Core	30
2.6.1 Amalgam	30
2.6.2 Glass ionomer	31
2.6.3 Composite	31
CHAPTER THREE: MATERIALS AND METHODS	32
3.1 Materials	33
3.2 Methods	35
3.2.1 Teeth collection	35
3.2.2 Teeth selection	36
3.2.3 Teeth decoronation	36
3.2.4 Canal preparation and obturation	38
3.2.5 Grouping	40

3.2.6 Removing Gutta-Percha	42
3.2.7 Post space preparation	42
3.2.7.(a) F4 Groups (P10, P7.5 and P5)	43
3.2.7.(a).(i) Group P10	44
3.2.7.(a).(ii) Group P7.5	44
3.2.7.(a).(iii) Group P5	45
3.2.7.(b) F2 Groups (P10, P7.5 and P5)	46
3.2.7.(c) F0 Groups (P10, P7.5 and P5)	46
3.2.8 Post placement and cementation	46
3.2.9 Core build up	47
3.2.10 Tooth mounting	47
3.2.11 Preparation	49
3.2.12 Crown fabrication and cementation	51
3.2.13 Thermocycling	52
3.2.14 Testing procedure	52
3.2.15 Failure mode evaluation	54
3.2.15.(a) Favourable failure modes	54
3.2.15.(b) Unfavourable failure modes	54
3.2.16 Data analysis	55
CHAPTER FOUR: RESULTS	56
4.1 Failure loads	57
4.1.1 Descriptive statistics for the failure loads	57
4.1.2 The effect of ferrule height and post length on fracture load	57
4.2 The effect of ferrule height and post length on failure mode	60

CHAPTER FIVE: DISCUSSION	64
5.1 Methodology	65
5.1.1 Teeth collection and selection	65
5.1.2 Teeth decoronation	65
5.1.3 Canal preparation and obturation	66
5.1.4 Post space preparation	67
5.1.5 Post cementation	69
5.1.6 Tooth mounting	70
5.1.7 Crowns fabrication	70
5.1.7 Thermocycling	71
5.1.8 Loading	71
5.2 Results	72
5.2.1 The effect of ferrule height on fracture resistance	72
5.2.2 The effect of post length on fracture resistance	76
5.2.3 Failure mode	78
5.3 Limitations of the study	82
5.4 Conclusions	83
CHAPTER SIX: RECOMMENDATIONS FOR FURTHER STUDIES	84
6.1 Recommendations for further studies	85
References	86
Appendices	102
Appendix I List of materials used in the study	103
Appendix II List of equipment/ instruments used in the study	104
Appendix III Raw data	105
Appendix IV Homogeneity test	106

Appendix V Statistical analysis tables for the effect of ferrule height and post length on the failure load by Two-way ANOVA test. 107

Appendix VI Statistical analysis tables for the effect of ferrule height and post length on the failure mode 110

LIST OF FIGURES

Figure	Description	Page
3.1	RelyX™ fibre post	33
3.2	RelyX™ Unicem Aplicap and Elongation tip	34
3.3	Filtek Z350 composite build up material	34
3.4	The collected teeth	35
3.5	The numbered teeth prepared for x ray	36
3.6	Teeth decoronation	37
3.7	Specimen's lengths were assigned as: (a) 19 mm, (b) 17 mm and (c) 15 mm using digital caliper.	37
3.8	Grinding and polishing machine	38
3.9	AH Plus™ root canal sealer	40
3.10	Grouping of the specimens	41
3.11	RelyX™ Fibre post with it's matching drill	43
3.12	RelyX™ Fibre post with it's matching drill were cut 2.5 mm from their apical end	45
3.13	RelyX™ Fibre post with it's matching drill were cut 5 mm from their apical end	45
3.14	A tooth fixed in milling machine	48
3.15	Specification of restored tooth in mounting block	49
3.16	Core preparation with paralleling device	50
3.17	The fixed specimen subjected to a horizontal cut by using diamond disc attached the surveyor	51
3.18	Thermocycling machine	52
3.19	Loading angels: A mounted specimen was fixed in this jig at an angle 45° to the horizontal plane and 135° to the loading rod tip	53

3.20	Specimens fixed in Instron Universal testing machine (A) before loading (b) after loading	53
3.21	Failure modes	55
4.1	The mean failure load for each post length subgroup	57
4.2	Mean failure loads for ferrule height groups	59
4.3	Mean failure loads for post length groups	60
4.4	Samples of favourable failure modes (A) post length 10 mm (B) post length 7.5 mm subgroups	62
4.5	Samples of favourable failure modes in post length 5 mm Subgroups	62
4.6	Samples of unfavourable failure modes in post length 10 mm subgroups	62
4.7	Samples of unfavourable failure modes (A) post length 5 mm (B) post length 7.5 mm subgroups	63
4.8	Unfavourable failure modes	63

LIST OF TABLES

Table	Description	Page
3.1	The post system used in this study	33
3.2	Components of resin cement	34
3.3	Components of the composite core build up material	35
3.4	Ferrule heights and post lengths assigned to the study groups	42
4.1	Two-way ANOVA for the effect of ferrule height and post Length on fracture load	58
4.2	Post hoc test multiple comparisons for the ferrule heights	59
4.3	Descriptive statistics of failure modes	61
I.1	Materials used in the study	103
II.1	Equipments/Instruments used in the study	104
III.1	Raw data	105
V.1	Descriptive statistic	107
V.2	Levene's test of Equality of Error Variances	107
V.3	Test of between-subject effects	108
V.4	Grand mean	108
V.5	Ferrule height	108
V.6	Post length	109
V.7	Ferrule height	109
V.8	Post length	109
VI.1	Failure mode* Groups Crosstabulation	110

