

An In Vitro Study of the Influence of
Remaining Coronal Tooth Structure on the
Fracture Resistance of Endodontically-Treated
Maxillary Premolars

A Thesis submitted in partial fulfillment of the
requirements for the degree of
Doctor of Clinical Dentistry

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This thesis is dedicated to my family:

My late father

He always encouraged and inspired me. Without him I wouldn't have ever achieved what I did.

My husband; Ehab and my lovely kids; Karim and Sandra

They are always there cheering me up and stood by me through the good times and bad.

My mother and my sister

They are always supporting me with their best wishes.

TABLE OF CONTENTS

Declaration	i
Acknowledgment	ii
List of Tables.....	iii
Abstract:.....	vii
1. Introduction.....	1
2. Review of literature.....	3
2.1 <i>In vitro</i> testing of teeth	3
2.1.1 Effect of storage media on the strength	3
2.1.2 Thermocycling protocol.....	3
2.1.3 Mounting samples for testing.....	4
2.1.4 Periodontium simulation	5
2.1.4 Type of load.....	6
2.1.6 Direction of load.....	6
2.2 Computer simulation studies.....	8
2.3 Clinical trials.....	8
2.4 Anatomy of upper premolars.....	10
2.5 Causes of weakness of endodontically-treated teeth.....	13
2.6 Effect of remaining tooth structure on the fracture resistance.....	14
2.7 Ferrule	17
2.8 Measuring the remaining tooth structure	21
2.8 Restoration of endodontically-treated teeth.....	22
2.8.1 Different core materials used.....	24

2.8.2 The use of full crowns	26
3. Aim of the study	29
4. Materials and Methods	30
4.1 Collection of teeth	30
4.2 Specimen preparation	31
4.3 Root canal preparation:	32
4.4 Full crown preparation	33
4.5 Sample grouping:	34
4.6 Surface area analysis:	35
4.7 Core build up	40
4.8 Crown fabrication	40
4.9 Thermocycling	42
4.10 Mounting of samples	43
4.11 Fracture testing.....	45
4.12 Data analysis	47
5. Results.....	48
5.1. Surface area analysis	48
5.2. Fracture strength	51
5.3. Mode of failure	55
5.4. Relation between the dentine surface area and the fracture strength.....	57
6. Discussion.....	58
6.1 Selection of teeth.....	58
6.2 Surface area measurement.....	59
6.3 Influence of the amount of remaining coronal tooth structure on the fracture resistance.....	60

6.4 Influence of the remaining coronal tooth structure location on the fracture resistance:	61
6.5 Fracture resistance values	63
6.6 Mode of fracture	69
6.7 Limitations of the study	70
6.8 Suggestions for further research	71
7. Conclusion:	72
8. References	73
9. Appendix	95

DECLARATION

I, Amal Ibrahim declare that this work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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LIST OF TABLES

Table 1: Sample grouping according to the missing wall(s)	34
Table 2: A summary of mean and standard deviation of the remaining dentine surface area of samples in mm ³	49
Table 3: Results for ANOVA statistical test for the surface area	49
Table 4: Probability values for pair-wise comparisons of means of the remaining tooth surface area.....	50
Table 5: A summary of mean and standard deviation of the failure loads of samples in Newton.....	52
Table 6: Results of the ANOVA statistical test for the fracture resistance values.....	53
Table 7: Probability values for pair-wise comparison of means of the fracture strength	54
Table 8: Mode of failure of samples in different groups	55

LIST OF FIGURES

Figure 1: Diagram showing the difference between functional and non-functional cusps of upper premolars.....	11
Figure 2: Photograph of maxillary premolar sectioned at buccal and lingual cusp tips. Functional cusp(Lingual on the right) is 44% of buccolingual width. Photograph taken from from Khera <i>et al.</i> ⁴³	11
Figure 3: Anatomy of upper premolar (Image taken from http://dentallecnotes.blogspot.com.au).....	12
Figure 4: A schematic drawing of endodontically-treated tooth restored with post and core system and a crown. Co=core, Cr=crown, F=ferrule, G=Gutta percha, P=Post. (Drawing taken from Juloski <i>et al</i> ¹	18
Figure 5: Proximal view of upper premolar	30
Figure 6: Occlusal view of upper premolar tooth	31
Figure 7: Occlusal view of upper premolar tooth with endodontic access cavity and root canal obturation.....	32
Figure 8: Occlusal view of upper premolar after endodontic occlusal access cavity and crown preparation.....	33
Table 1: Sample grouping according to the missing wall(s): O= Occlusal access, Px= Proximal, P=Palatal, B= Buccal, M= Mesial, D= Distal	34
Figure 9: Sample grouping.....	35
Figure 13: Measuring the surface area of the sectioned dies using imagej computer software	39

Figure 14: The percentages of the main constituents of the alloy used (Argeloy Sunray, The Argen Cooperation, USA).....	41
Figure 15: Proximal view of the tooth after crown cementation.....	41
Figure 16: Thermocycling machine	42
Figure 17: Mounting of the tooth in the brass ring using the surveyor	44
Figure 18: The brass cylinder was placed in a water bath as the acrylic resin is polymerized.....	45
Figure 19 : Tooth mounted in the Universal testing machine with the chisel end rod applying load to the palatal incline of the buccal cusp at 45 degree angle	46
Figure 20: plot graph for a sample of group 1.....	47
Figure 21: Bar chart for mean surface area values of all groups	48
Table 2 A summary of mean and standard deviation of the remaining dentine surface area of samples in mm ³	49
Table 3: Results for ANOVA statistical test for the surface area	49
Table 4: Probability values for pair-wise comparisons of means of the remaining tooth surface area	50
Table 5 A summary of mean and standard deviation of the failure loads of samples in Newton.	52
Figure 22: Bar chart of the mean fracture values for all groups	53
Table 6: Results of the ANOVA statistical test for the fracture resistance values.....	53
Table 7: Probability values for pair-wise comparison of means of the fracture strength	54
Table 8: Mode of failure of samples in different groups	55
Figure 24: Correlation between Surface area (X-axis) and the fracture strength (Y-axis).....	57

Figure 25: Plot chart to show the surface area and the fracture resistance values for group1 (Oclussal). The area showing the mean value \pm 1 standard deviation.	65
Figure 26: Plot graph showing the surface area and the fracture resistance values for the groups with three remaining dentine walls. The areas showing the mean values \pm 1 standard deviation for each group.	66
Figure 27: Plot graph showing the surface area and the fracture resistance values for the two remaining walls groups. The areas showing the mean values \pm 1 standard deviation for each group.....	67
Figure 28: plot graph showing the surface area and the fracture resistance values for the one remaining wall groups. The areas showing the mean values \pm 1 standard deviation for each group.....	68

ABSTRACT

Objectives: This *in vitro* study investigated the relationship between the cross-sectional area and the location of remaining coronal tooth structure and the fracture resistance of restored endodontically-treated teeth.

Materials and Methods: Fifty-five extracted maxillary premolars received root canal treatment and crown preparation and were randomly divided into 11 groups of five teeth each according to the number and the site of the missing axial wall(s). Impressions of the prepared teeth were taken and poured with epoxy resin to construct a die for each tooth that was then sectioned 1mm above the finish line. The surface area was measured using ImageJ software (version 1.41n. Developed by Wayne Rasband. National Institutes of Health, USA.¹ All 55 prepared teeth were then restored with composite resin cores, and cast metal crowns. Specimens were thermocycled between 5°C and 55°C for 500 cycles, prior to testing. A universal testing machine was used to apply a compressive load at a crosshead speed of 1mm/min to the palatal surface of the buccal cusp of the crown at an angle of 45 degrees to the long axis of the tooth until failure. Results were analyzed using one-way ANOVA and t-tests.

Results: Specimens with all axial walls intact (only access cavity) had mean fracture strength of 1380.5±393.9N. Groups that have a missing palatal wall with one or two proximal walls showed the lowest mean failure loads of 398.4N ± 149.5N and 344.7N ±

91.2N respectively. The coefficient of determination (R^2) between the surface area and the fracture resistance was 0.52.

Conclusions: For restored endodontically-treated upper premolars there is a positive linear relationship between the remaining dentine surface area and fracture strength. Residual dentine location influences the fracture resistance with the palatal wall having a major role in resisting force.