

*The Fracture Resistance of Endodontically Treated Maxillary
Centrals Restored With Laminate Veneers Versus All Ceramic
Crowns*

Thesis

Submitted to Crown and Bridge Department

Faculty of Dentistry, Ain Shams University.

In Partial Fulfillment of the Requirements of the Master Degree
in Fixed Prosthodontics

By:

Kamal El-Sayed Goda El-Sayed

B.D.S Ain Shams University (2003)

H.D.D. Ain Shams University (2005)

.

**Faculty of Dentistry
Ain Shams University
2016**

SUPERVISORS

DR. AMINA MOHAMED HANDY

Professor of fixed prosthodontics

Faculty of Dentistry

Ain Shams University

DR. MARWA MOHAMED WAHSH

Assistant Professor of fixed prosthodontics

Faculty of Dentistry

Ain Shams University

Acknowledgement

First, I would like to express my utmost gratitude and great appreciation to *Prof. Dr. Amina Hamdy*, Professor of fixed prosthodontics, Faculty of Dentistry, Ain Shams University, for her academic supervision, continuous encouragement and valuable advices that she offered throughout the accomplishment of this work under her supervision.

Finally, My due thanks to *Dr. Marwa Wahsh* Assistant Professor of fixed prosthodontics, Faculty of Dentistry, Ain Shams University for offering me most generously from her valuable scientific knowledge and experience in reviewing this work.

Finally, I wish to extend my sincere thanks to all staff members of crown and bridge Department Faculty of Dentistry, Ain Shams University for their kind support & cooperation.

Dedication:

This work is dedicated to

*My dear father, my dear mother, my dear
family and all of my dear friends.*

*And special dedication to the soul of my
dear friend*

Dr. Ahmed Abd El-Hameed

who I miss so much

LIST OF CONTENTS

<u>List of Tables</u>	IV
<u>List of figures</u>	V
<u>Introduction</u>	1
<u>Review of literature</u>	3
<u>Effect of root canal treatment on tooth structure</u>	3
<u>Various concepts for successful restoration of endodontically treated teeth</u>	4
<u>laminate veneer</u>	6
<u>Veneers can be divided into two categories based method of fabrication</u>	8
<u>Advantages of Indirect Veneers Over Direct Veneers:</u>	8
<u>Indirect Composite Veneer</u>	8
<u>Ceramic veneer</u>	11
<u>All-Ceramics</u>	13
<u>Lithum disilicate</u>	15
<u>Indication of crown placement</u>	17
<u>Indications for post Placement</u>	18
<u>Post effect on remaining tooth</u>	20
<u>Non metallic post</u>	21
<u>Bonding of fiber post</u>	23
<u>Limitation of dentin bonding</u>	23
<u>Silanization of fiber post</u>	24
<u>Fracture resistance test</u>	26
<u>Aim of Study</u>	30
<u>Materials and Methods</u>	31
<u>Materials used in this study were as follow</u>	31
<u>Methodology</u>	34
<u>1. Teeth selection</u>	34
<u>2. Samples Grouping</u>	34
<u>I. Group I; control group</u>	34
<u>II. Group II: Indirect composite veneer</u>	34
<u>III. Group III: Ceramic veneer</u>	34
<u>IV. Group IV: Ceramic crown without glass fiber post</u>	34
<u>V. Group V: Ceramic crown with glass fiber post</u>	35
<u>3. Teeth preparation</u>	35
<u>3.1. Endodontic treatment</u>	35
<u>3.1.1. Access cavity preparation</u>	35

3.1.2. Root canal instrumentation.....	37
3.1.3. Obturation.....	38
4. Mounting Teeth in acrylic blocks:.....	41
<u>Tooth restoration:.....</u>	44
<u>5. Preparation of the post space and post cementation.....</u>	44
<u>6. Preparation to receive laminate veneer for the group II and III.....</u>	46
6.1. Facial reduction.....	46
6.2. Proximal reduction.....	46
6.3. Incisal Butt-Joint preparation.....	46
6.4. Finishing preparation.....	47
<u>7. Preparation to receive full coverage restoration for group IV and V:.....</u>	47
7.1. Incisal reduction.....	47
7.2. Facial reduction.....	57
7.3. Lingual reduction.....	48
<u>8. Impression for all groups except group I.....</u>	48
<u>9. Die construction.....</u>	48
<u>10. Restoration construction.....</u>	49
10.1. Indirect composite veneer:.....	49
10.2. E,max ceramic veneer and full coverage restoration.....	50
10.2.1. Waxing up.....	50
10.2.2. Investing:.....	50
10.2.3. Preheating:.....	51
10.2.4. Pressing:.....	52
<u>10.2.5. Divesting:.....</u>	53
<u>11. Cementation.....</u>	56
<u>12. Fracture resistance Testing.....</u>	59
<u>13. Data collection and analysis:.....</u>	61
<u>Results.....</u>	62
1) <u>The effect of material of laminate veneer on their fracture resistance:.....</u>	62
2) <u>The effect of post presence on fracture resistance of full coverage restorations:.....</u>	64
3) <u>The effect of the type of restoration on their fracture resistance regardless other factors:.....</u>	65

4) <u>Interaction between all variables:</u>.....	67
<u>Discussion</u>.....	69
<u>Summary and conclusion</u>.....	75
<u>Clinical implication</u>.....	77
<u>References</u>.....	78
<u>Arabic summary</u>.....	

LIST OF TABLES

Table No.	Title	Page No.
Table 1	Material used in the present study	31
Table 2	Factorial experimental design	35
Table 3	The mean, standard deviation (SD) values of fracture resistance in laminate veneers.	63
Table 4	The mean, standard deviation (SD) values of fracture resistance in full coverage groups.	64
Table 5	The mean and standard deviation (SD) values of fracture resistance between laminate veneer and full coverage restorations.	66
Table 6	The mean, standard deviation (SD) values of fracture resistance in all groups.	68

LIST OF FIGURES

Figure No.	Title	Page No.
Figure (1);	Access Cavity.	36
Figure (2);	Master Apical file.	37
Figure (3);	Dispensing of the endodontic sealer.	38
Figure (4);	Condensation technique.	39
Figure (5);	Master cone.	40
Figure (6);	Removal of excess gutta-percha.	40
Figure (7);	X-Ray showing endodontically treated central incisors	41
Figure (8);	Mounting device parts: A. Wooden base B. Plastic holder C. Vertical arm D. Vertical rod with attached needle	42
Figure (9);	Attached tooth was moved downward.	43
Figure (10);	Sample mounted in acrylic block.	43
Figure (11);	Preparing the central incisors for fiber post.	44
Figure (12);	Fiber post inserted in the prepared root canal.	45
Figure (13);	Individual impression in a sectional tray.	48
Figure (14);	Stone die.	49
Figure (15);	IPS e.max Press ingot was placed into the hot investment ring.	51
Figure (16);	IPS e.max Furnace.	52
Figure (17);	The investment ring placed at the center of the IPS e.max Furnace.	53
Figure (18);	The investment ring was separated at a distance of at least 30 mm from the bottom surface using a separating disk.	53
Figure (19);	Sample was broken at the predetermined breaking point.	54
Figure (20);	Rough divesting was carried out with polishing beads at 4 bar (58 psi) pressure until the objects become visible	54
Figure (21);	The reaction layer from the contact surfaces was completely removed using Al ₂ O ₃ at 1 – 2 bar (15 – 29 psi) pressure.	55
Figure (22);	Restoration attached to the sprue after pressing.	55
Figure (23);	Dispensing of the cement.	56
Figure (24);	Application of monobond.	57
Figure (25);	Application of Variolink cement.	58

Figure No.	Title	Page No.
Figure (26);	Diagram showing the point of application in fracture test.	60
Figure (27);	Universal testing machine.	60
Figure (28);	Bar chart representing means of fracture resistance for laminate veneers.	63
Figure (29);	Bar chart representing means of full coverage groups of fracture resistance.	65
Figure (30);	Bar chart representing fracture resistance between laminate veneers and full coverage restorations.	66
Figure (31);	Bar chart representing means of all groups of fracture resistance.	68

Introduction

It has been reported that root canal treated teeth undergo changes in mechanical properties, most reduction in fracture strength. In some studies, however, changes in properties such as modulus of elasticity and proportional limit, compressive strength, or brittleness have not been observed for these teeth.^(1, 2)

Reduction in the strength of endodontically treated teeth is therefore most likely caused by the degradation in structural integrity resulting in the substantial loss of tooth structure, which takes place during root canal therapy and cavity preparation.⁽¹⁾ The longevity of a restored tooth thus depends influenced by the quantity of remaining tooth structure and on the efficiency of the restorative technique used to substitute lost structural integrity.⁽³⁾

The amount of internal dentin structure has been directly correlated with the fracture resistance of root canal treated teeth. In popular clinical practice, teeth with insignificant coronal structure are seen with great frequency.^(4, 5)

When the remaining tooth structure is not appropriate to retain a crown, a post is indicated to provide retention. Prefabricated glass fiber posts have gained popularity and have been used as a substitute for custom metallic posts. Glass fiber posts are easily bonded to the dental structure with the use of adhesive systems and resin cements⁽⁶⁾, and they have modulus of elasticity closer to that of dentin. When bonded with dentin, glass fiber posts may provide adequate stress distribution on the tooth and may decrease the incidence of catastrophic root fractures.

With the improvement of resin cements, ceramics can be effectively bonded to tooth structure in order to improve fracture resistance and also provide respectable alternatives for reestablishing esthetics,

Ceramic veneers were presented and have been used over the previous decades ⁽⁷⁾ offering long-lasting anterior restorations using superior esthetics. ^(8, 9)

New dental material technique has been introduced to fabricate esthetic ceramic restoration with improved strength and marginal adaptation. ^(10, 11) Although crown restoration has been promoted as a means to strengthen a tooth after endodontic treatment, tooth fractures are common even after crown placement still unresolved controversy exists concerning the best technique for restoring root canal treated teeth.

Review of literature

Endodontically treated tooth should have a good prognosis; it can resume full function and serve satisfactorily as an abutment for fixed or removable prosthesis. According to biological considerations of endodontically treated teeth, some factors must be mentioned because endodontically treated teeth have a higher degree of failure due to many effects like teeth dehydration. This was based on a study which compared to a moisture content of vital and nonvital teeth obtained from dogs. They found that there was 9% less moisture present in the calcified tissues of the non-vital teeth.⁽¹⁾

Endodontically treated teeth usually require post and core restorations for retention purposes due to extensive structural defects resulting from dental caries and access cavity preparation.^(1,3) The use of glass fiber posts in combination with composite resin core foundation materials for the restoration of pulpless treated teeth is at this time a widely accepted viable alternative to cast posts and cores.

Effect of root canal treatment on tooth structure:

Root filled teeth are weaker than filled ones due to decrease dentin moisture, loss of dental structure and root canal preparation which will limit tooth deformation capacity under loading, thus increasing the potential for tooth fracture. It is thought that the dentin in root canal treated teeth is substantially more brittle than dentin in teeth with vital pulp, probably because of loss of water and collagen loss cross linking⁽¹⁰⁾.

Despite this finding, **Hung et al. in (1991)⁽¹¹⁾** compared the physical and mechanical properties of dentin specimens from teeth with and without endodontic treatment at different levels of hydration. It was concluded that neither hydration nor endodontic treatment caused degradation of the physical or mechanical properties of dentin.

Sedgely and Messer in (1992)⁽¹²⁾ tested the biomechanical properties of dentin from twenty three endodontically treated teeth with an average of ten years of post treatment. It was claimed that the loss of structural integrity associated with the access preparation, rather than changes in the dentin, that lead to a higher occurrence of fractures in endodontically treated teeth compared with "vital" teeth. Access preparation result in increased cuspal deflection during function and increase the possibility of cusp leakage at the margins of restoration.

Fennis et al. (2002)⁽¹³⁾ studied more than 46,000 patients from insurance claims and reported significantly more fractures in teeth with root canal treatment. Taken together, these studies show that restoration that increase structural integrity would be expected to increase prognosis of root canal treated teeth exposed to high masticatory loading forces.

Endodontically treated teeth are potentially weaker than vital teeth against masticatory forces and may fracture more easily. For last decades, post and core systems have been used as foundational materials for the final restoration of root canal treated teeth that have lost most of their coronal tooth structure. Posts and cores can be custom-made or prefabricated.⁽¹⁴⁾

Bassir et al. in (2013)⁽¹⁵⁾ evaluated the fracture resistance and the mode of fracture of endodontically treated human premolars with different amounts of remaining tooth structure. It was concluded that teeth with adhesive restorations showed significantly higher fracture resistance values as compared with the non-restored ones.

Various concepts for successful restoration of endodontically treated teeth:

There is no consensus regarding the preferred type of final restoration for root canal treated teeth. There are 2 primary factors related to recommendation for crown replacement. These factors are the loss of tooth vitality and loss of tooth structure after endodontic treatment.

Complete coverage restoration is considered an optimum treatment and should provide improved longevity of endodontically treated teeth. One of the most widely quoted series of studies on endodontically treated teeth exacerbates the effect of tooth location, coronal coverage and intra-coronal reinforcement on the success of 1273 RCT teeth over an observation period of 1 to 25 years. ⁽¹⁶⁾

Failures were described as dislodgment, root or tooth fracture, and iatrogenic perforation. The result indicated that the placement of a post had no significant effect on the success degree for either anterior or posterior teeth. Crown placement has no significantly improved clinical success rate of posterior teeth. In two subsequent analyses of the same data set the authors described failure as either restorable or requiring extraction. No additional analysis was performed on either of those failure categories. The greatest failure proportion (24.2%) was documented for RCT teeth without a crown. Although the results of these studies have been questioned due to lack of clinical procedures and generalizability they have been used to support the concept that crowns commonly should be used on endodontically treated posterior teeth and on anterior teeth with substantial loss of teeth structure. ⁽¹⁷⁾

Denhey and Torney in (1976) ⁽¹⁸⁾ first proposed to the use of adhesive materials to reinforce weakened teeth to support undermined enamel. Further studies have shown that the weakening effect of preparation can be alleviated with the use of adhesive materials. Such materials not only seal the margin but also increase the retention as well as resistance form of the restored tooth. Re-establishing a patient's lost natural dental esthetics is among the significant topics of today's dentistry, furthermore to function and foundation. Color, shape, besides structural and position abnormalities of anterior teeth might lead to significant esthetic problems for patients. In order to solve these problems, the technique chosen usually is to cover the teeth with dental crowns. However, extreme preparations of teeth and damages to surrounding tissues, for example gingiva, are some disadvantages of crowns. Thus, nowadays