

Effect of retainer design and material on the fracture resistance of three unit bridge on endodontically treated abutments

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بسم الله الرحمن الرحيم
(قالوا سبحانك لا علم لنا الا ما علمتنا انك انت
العليم الحكيم)
صدق الله العظيم

سوره البقره ايه 32

List of CONTENTS

	Page
List of Tables.....	i
List of Figures.....	iv
Introduction.....	1
Review of Literature.....	3
Aim of the study.....	29
Materials and Methods.....	30
Results.....	83
Discussion.....	98
Summary and Conclusion.....	104
References.....	106
Arabic Summary	

List of tables

<i>Table (1):</i> Materials used in this study.....	page 30
<i>Table (2):</i> Samples grouping.....	33
<i>Table (3)</i> testing parameters.....	79
<i>Table (4)</i> Descriptive analysis results as function of material group and restoration type.....	84
<i>Table (5)</i> Fracture resistance results (Mean $\pm$ SD) as function of material group and restoration type.....	85
<i>Table (6)</i> Two way analysis of variance ANOVA test of significance comparing variables affecting fracture resistance results.....	86
<i>Table (7)</i> Comparison between total fracture resistance as function of Restoration type	86
<i>Table (8)</i> Comparison between total fracture resistances as function of material group.....	87
<i>Table (9)</i> Frequent distribution of fracture pattern among material group and restoration type.....	91

List of Figures

<i>Figure (1)</i> IPS e.max press ingots.	page 31
<i>Figure (2)</i> Bio HPP granules	31
<i>Figure (3)</i> Computerized numerical control milling machine.....	34
<i>Figure (4)</i> preparations of full coverage abutment.....	35
<i>Figure (5)</i> occlusal preparation.....	35
<i>Figure (6)</i> Internal preparation.....	36
<i>Figure (7)</i> paralleling device.....	38
<i>Figure (8)</i> Optical impression 3Shape D500.....	38
<i>Figure (9)</i> Virtual models	39
<i>Figure (10)</i> 3D printing machine.....	40
<i>Figure (11)</i> 3D printed models.....	40
<i>Figure (12)</i> duplicating material.....	41
<i>Figure (13)</i> Silicon indexes.....	41
<i>Figure (14)</i> Epoxy resin models.....	41
<i>Figure (15)</i> CAD Wax patterns.....	44
<i>Figure (16)</i> spruing the pattern.....	46
<i>Figure (17)</i> The patterns were fitted on the investment ring base.....	47
<i>Figure (18)</i> investment material (IPS press VEST speed).....	47
<i>Figure (19)</i> Ring filled with investment material.....	48

Figure (20) The ring left to set without manipulating.....	49
Figure (21) Preheating step.....	49
Figure (22) e-max ingot placed into the hot investment ring.....	51
Figure (23) placement of cold IPS Alox plunger.....	51
Figure (24) start of the pressing cycle.....	52
Figure (25) Investment ring placed on the cooling grid.....	52
Figure (26) separating of the investment ring.....	54
Figure (27) Rough divestment.....	55
Figure (28) Fine divestment.....	55
Figure (29) The restorations immersed in the Invex Liquid.....	56
Figure (30) cutting of the attachment sprue.....	57
Figure (31) Glazing process.....	57
Figure (32) The patterns of Bio HPP were fitted on the investment ring base.....	60
Figure (33) investment material for Bio HPP.....	60
Figure (34) Ring filled with investment material.....	61
Figure (35) wax burnout.....	61
Figure (36) ring filled with Bio HPP granules.....	62
Figure (37) Melting of Bio HPP granules	62
Figure (38) pressing step.....	63
Figure (39) blasted of PEEK framework.....	66
Figure (40) visio link applications.....	66

Figure (41) breLux power unit.....	67
Figure (42) silicon index.....	67
Figure (43) (A)combo.lign opaque and (B)of crea.lign opaque.....	68
Figure (44) application of opaque materiala.....	68
Figure (45) Crea.lign Enamel and Dentin shades.....	69
Figure (46) composite application.....	69
Figure (47) Finishing kit.....	70
Figure (48) A, B and C: bridges after finishing and polishing.....	70
Figure (49) RelyX Ultimate resin cement.....	74
Figure (50) epoxy model after sandblasting.....	74
Figure (51) application of hydrofluoric acid.....	75
Figure (52) Curing of the bond.....	75
Figure (53) Equal amount of cement was dispensed.....	76
Figure (54) gentle finger pressure.....	76
Figure (55) constant static load.....	77
Figure (56) ROBOTA chewing simulator Machine.....	80
Figure (57) specimens in its place during chewing simulating test.....	81
Figure (58) Instron testing machine.....	81
Figure (59) fracture of specimen under load	82
Figure (60) Histogram of descriptive analysis results as function of material group and restoration type.....	84

Figure (61) Histogram of fracture resistance mean values as function of material group and restoration type.....	85
Figure (62) Column chart of fracture resistance mean values as function of restoration type.....	87
Figure (63) Column chart of fracture resistance mean values as function of material group	88
Figure (64) Pie chart representing distribution of fracture pattern for subgroup 1A.....	92
Figure (65) showing a fracture pattern for subgroup 1A.....	92
Figure (66) Pie chart representing distribution of fracture pattern for subgroup 1B.....	93
Figure (67) showing a fracture pattern for subgroup 1B.....	93
Figure (68) Pie chart representing distribution of fracture pattern for subgroup 2A.....	94
Figure (69) showing a fracture pattern for subgroup 2A.....	94
Figure (70) Pie chart representing distribution of fracture pattern for subgroup 2B.....	95
Figure (71) showing a fracture pattern for subgroup 2B.....	95
Figure (72) Pie chart representing distribution of fracture pattern for subgroup 3A.....	96
Figure (73) showing a fracture pattern for subgroup 3A.....	96
Figure (74) Pie chart representing distribution of fracture pattern for subgroup 3B.....	97
Figure (75) showing a fracture pattern for subgroup 3B.....	97

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Dedication

To the most precious, supportive, and sincere people in my life

To my family

*“Without your endless love and encouragement,
I would have never been able to be who I am or where I am
Thanks for supporting me throughout the rough way”*

The conventional restoration protocol for endodontically treated teeth with excessive coronal loss has been metal post and core followed by a complete crown. The use of glass fiber posts combined with the dentin bonding technique made the restoration of endodontically treated teeth more straightforward, biocompatible, and economical.⁽¹⁾ Initially, the post was thought to reinforce the remaining tooth structure.⁽²⁾ However, several studies have shown variable results with high incidences of root fracture, indicating that excessive removal of tooth structure to place a post further weakens the root.⁽³⁾

The advent of high-strength ceramic materials and the progress made in adhesive dentistry has resulted in restoring posterior teeth without the use of a post and core.⁽⁴⁾ Teeth with excessive coronal loss can be restored with the use of the endocrown.

The first endocrown report was made by Pissis⁽⁵⁾ in 1995 and is known as “the monoblock porcelain technique.” In 1999, Bindl and Mörmann⁽⁶⁾ used the term “endocrown” to describe a ceramic crown which extends into the pulp chamber or the root canal orifices of an endodontically treated tooth in order to gain retention.

Endocrowns have been recommended for teeth with short clinical crowns and calcified, short, or curved root canals that make post and core restorations impossible, also can be used in patients with limited interocclusal space, which prevents adequate thickness for both the ceramic veneer and the metal or ceramic framework.⁽⁷⁾ But if depth of pulp chamber is less than 3mm or cervical margin is less than 2 mm wide and if adhesion cannot assured, in such cases endocrowns are contraindicated.⁽⁸⁾

A high-performance polymer, polyetheretherketone (PEEK) has recently been introduced in dentistry. It has been used for the fabrication of implant fixtures, fixed and removable dental prosthesis frameworks, and for implant frameworks and restorative implant parts.⁽⁹⁾

A modified PEEK material containing 20% ceramic fillers (BioHPP; Bredent GmbH) can be used for the fabrication of prostheses either by injection molding or CAD-CAM procedures. The advantages of using this material are the elimination of allergic reactions, good mechanical properties, good wear resistance, good polishing properties, and low plaque affinity.⁽¹⁰⁾

Therefore, the concept of using the new materials to construct endocrown retained bridge is considered in the present study.

The increasing demand for esthetic restorations has led to increased acceptance of all-ceramic fixed partial dentures (FPDs) for use in posterior regions of the mouth. There are few reliable clinical studies documenting the longevity of these restorations. All-ceramic FPDs have several advantages compared to metal or metal-ceramic FPDs. Primarily, the esthetics obtained using all-ceramic restorations is unrivaled because of their increased translucency and light transmission. Other advantages include biocompatibility, less tooth reduction, low thermal conductivity, less periodontal pathology because of supragingival placement of margins, and ease of patient access for hygiene purposes.⁽¹¹⁾

Clinical studies of all-ceramic FPDs showed comparable longevity of 90% to 93% within a 5-year observation period. This is lower than survival rates of 95% to 97.7% for metal-ceramic FPDs after 5 to 7.5 years. Despite the slightly lower survival rate, ceramic FPDs are still indicated, primarily for esthetic reasons. With greater esthetic demands from the general population, it is easier to achieve esthetic results with ceramic prostheses with less tooth reduction (1.0 to 1.5 mm) compared with that of metal-ceramic prostheses for anterior restorations (1.2 to 1.7 mm).⁽¹²⁾

All-ceramic restorative systems have to fulfill biomechanical requirements and should provide longevity similar to metal-ceramic restorations while providing enhanced esthetics. However, it must be taken into consideration that aging and stress fatigue in the oral environment, as well as function and para-function, all affect the longevity of all-ceramic restorations.⁽¹³⁻¹⁵⁾ Therefore, it is well established in the dental literature that evaluation of all-ceramic restorations over 5 years of service is the gold standard.⁽¹⁶⁾

The connector areas are the most influential in failure. Failure rate is relatively high in three unit all-ceramic bridges around the sharp connector area. The Fixed Dental Prosthesis shape is not uniform clinically, but is a complex combination of multiple convexities and concavities that depend on the geometry and alignment of the teeth. In all ceramic resin-bonded Fixed Dental Prosthesis, the occlusogingival height of the interdental connector must be as large as possible (minimum 4.0 mm). The connector area is usually narrowly constricted for biological or esthetic reasons, which typically considers stresses relative to the average stress levels in other areas of the prosthesis. The minimal recommended connector cross section area is 12-16 mm².⁽¹⁷⁾

A connector thickness of at least 4 mm is recommended for ceramic products with moderate strength and toughness, and a minimum thickness of 1.5 mm is recommended for the overall occlusal thickness of crowns. Compared with metal-ceramic prostheses, the fracture susceptibility of some all-ceramic crowns and FPDs is greater because of several important factors: (1) relatively low tensile and flexure strength, (2) low to moderate fracture toughness, (3) susceptibility to crack initiation in the presence of microscopic flaws, and (4) sensitivity to tensile stress in the core structure.⁽¹⁸⁾

The shape of an FPD is not uniform. Its contour has a complex combination of multiple convexities and concavities, depending on the geometry of the teeth and their alignment. In particular, the connector area has a narrow constriction for biologic and esthetic reasons, and these sites in 3-unit FPDs represent stress concentrations relative to the average stress levels within other areas of the prosthesis.^(19,20)