A Conservative Approach for Replacing Missing Maxillary 2^{nd} Premolar using Endodontically Treated Abutments

Thesis Submitted to Faculty of Oral and Dental Medicine,
Ain Shams University
For Partial Fulfillment of the Requirements for PhD Degree
In Fixed Prosthodontics

BY

Faisal Safwat Kamal Hamza

(B.D.S)
Misr University for Science and Technology (MUST)
(2004)

(M.Sc.)
Fixed Prosthodontics Department, Cairo University
(2011)

Assistant lecturer Fixed Prosthodontics Department,
MSA University

(2017)

Under Supervision of

Dr. Tarek Salah Morsi

Professor of Fixed Prosthodontics

Faculty of Dentistry,

Ain Shams University

Dr. Amr Saleh El-Etreby

Assistant Professor of Fixed Prosthodontics

Faculty of Dentistry,

Ain Shams University

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Introduction

The popularity of metal-ceramic restorations is wide due to the predictable strength achieved, in combination with reasonable esthetics. The drawback of such restorations is their increased light reflectivity as result of the opaque porcelain needed to mask the metal substrate. All ceramic materials offer an esthetic advantage leading to the success of all-ceramic crowns and patient demand for metal-free, tooth-colored restorations, which has led to the development and introduction of restorative systems for all-ceramic fixed partial dentures (FPDs).

High-strength all-ceramic systems for FPDs are available for replacing a missing tooth. New core/framework materials have been developed in the last decade. With the advancement of CAD/CAM technology, various fabrication techniques have been developed for fabricating improved, consistent and predictable restorations in terms of strength, marginal fit and esthetics. (1)

The primary reason for the reduction in stiffness andfracture resistance of endodontically treated tooth is attributed to its loss of structural integrity associated with caries, trauma and extensive cavity preparation, rather than dehydrationor physical changes in the dentin. The longevityof endodontic treatment is significantlyinfluenced with the type of restorative materials used and use of appropriate restoration that conserves the tooth structure. (2)

Accordingly, this study was designed to compare the performance of two bridge designs supported on endodontically treated abutments.

Review of Literature

1 Endodontically treated teeth

1.1 Teeth biomechanicalalterationscaused by endodontic treatment procedures

Fractures are more common in non-vital teeth than vital teeth. [3]Factors such as age, sex, anddental arch shape have proved to affect the liability of teeth fractures. [4]***Chan et al. (1999)***[5]observed that the rate of fractureswas 1.4 times higher in male than in female patients and mostfractures occurred in the age 40-49years'age in males andin the 50-59 years' age in females.

Endodontically treated teeth have high risk of fractures related to loss of tooth structure during the access cavity preparation and canal cleaning and shaping in addition to already missing tooth structure caused by caries or previous restoration attempts, which cause loss of structural integrity. [3]

Structural failure of the tooth may be caused by stresses exceeding tooth strength, those were produced during tooth loading. [6]

1.2 Dentin loss

Caries development associated with endodontically treated teeth may lead to flared root canals, and thinning the root canal dentinal wall. These thin walls are at risk of fracture under normal masticatory force.[7]That is whyto restore these weak teeth is considered a challenge.

Mastication contains a lot of lateral forces that result in bending forces on the root. These stresses affect mainly the external root surface at the cervical third. [8]

During endodontic treatment, a large amount of dentin is removed which will further weaken the teeth, moreover stresses applied during canal preparation and obturation will affect and are considered as stress raisers.[9]

1.3 Root dentin changes

The mechanical properties of dentin depend on its collagen structure, which can be affecteddue to mechanical preparation and chemical materials used during root canal treatment. [10]

Common canal irrigation materials, such as sodium hypochlorite (NaOCl) and chelatorssuch as ethelene diamine tetraacetic acid (EDTA) interact with root dentin, either with mineral content (chelators) or the organic substrate (sodium hypochlorite). [11]

Zhejun et al(2016) [12]examined the level of erosion in root dentin comparing different irrigation methods and protocols.They concluded that irrigation with NaOCl after EDTA should be kept away from or done with great concern to avoid chemical weakening of the root.They found that irrigation with 3% and 5% NaOCl after EDTA lead to rapid lossof dentinalCalcium and Phosphate contents of dentin, at least to the depth of 300µm indentin. They recommended recent methods such as GentleWave System.

Restoration of endodontically treated teeth

Survival of endodontically treated teeth depends on successful root canal treatments followed by adequate restoration.Many restorations are suggested to restore endodontically treated teeth depending on the condition of each tooth. [13]

Fabrication of coronal restoration after endodontic treatment should be done as soon as possible; to avoid microleakagecoronally, which may increase the probability of periapical contamination and failure. (14)

Challengesin restoring endodontically treated teeth are related to physical, chemical and mechanical changes in teeth nature during and after root canal treatment. (2)

Direct restoration:

Polesel (2014) (14)considereddirect restoration successful and applicable in cases with small amount of tooth structure loss during endodontic treatment, such as access cavity only, even if tooth loss involves only one marginal ridge.

Kovarik (2009)(15) agreed that restoring endodonticallytreated posterior teeth by composite is considered as a proper line of treatment and mainly in premolar region. On the other hand,***Weirong et al (2010)***(16)suggested full coverage restorations for all posterior teeth, except the lower 1st premolar in cases with underdeveloped lingual cusp, since there are no wedging forces of upper teeth.

Indirect Restorations:

Full coverage

Ferrule effect

Successful restoration of endodontically treated teeth can be attempted only if the prosthodontist takes into consideration the amount of the remaining tooth structure above the bone level, in order to produce a non-invasive restoration which can be away from the biological width and its margin on sound tooth structure.Both coronal and radicular remaining tooth