Internal Fitness of Anterior CAD/CAM Nanoceramic Composite Endocrown with Short and Long Root Canal Extension

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Dedication

This work is dedicated to

My Dear parents,

Beloved husband

And lovely son

Acknowledgment

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Introduction

Introduction

Restoration of endodontically treated teeth has long been a controversial topic, related to the fractures occurring in such teeth [1, 2]. Endodontically treated teeth are affected by a higher risk of biomechanical failure than vital teeth [3, 4]. The access preparation for endodontic treatment causes the loss of the roof of the pulp chamber, which may account for the relatively high fracture incidence documented in pulpless teeth [5]. Loss of moisture and collagen of dentin, all these factors make the prognosis of restoration of endodontically treated teeth poorer than that of vital teeth.

Posts either prefabricated or custom made, traditionally made of metal, have been used in these situations to provide the necessary retention for the subsequent prosthodontic restoration, but their use resulted in complex combinations of materials (dentin, metal posts, cements, and core materials) with different degrees of stiffness [6,7].

To date, with the increase in esthetic demands, esthetic fiber reinforced composite posts were developed. The advantages of the fiber post systems are the high tensile strength, their compatibility with the resin cements, as well as the similarity of their modulus of elasticity to that of dentin. This bio-mimetic feature can provide the homogeneous post/composite resin/ dentin structure needed for optimal stress distribution. Despite the cited advantages, the fabrication of custom made fiber post to fit in wide and elliptical canals as in case of anterior teeth is not applicable [8].

Computer-aided design and computer-aided manufacturing (CAD/CAM) technologies were developed as an alternative to the conventional casting method with the aim of producing dental restorations in a standardized, reproducible, and efficient way as well as being able to process new dental materials [9].

Endocrown is another restorative technique for endodontically treated teeth. Endocrown assembles the endocanalar-post, the core and the crown in one component [10]. The endocrown is described as a monolithic (one-piece) ceramic bonded construction [11,12] characterized by a supra-cervical butt joint [13], retaining maximum enamel to improve adhesion. The endocrown invades the pulpal chamber and possibly the root canal entrances [14]. It is milled using computer-aided techniques [15,12] or by molding ceramic materials under pressure [16,17] (pressing technique). New generations of ceramics and adhesives may lead to a view of this therapeutic device as an alternative to conventional crown-root anchored restorations [18, 19]. The specific preparation and bonding result in a particularly favorable reconstruction in terms of biomechanics [20, 21, 22].

The use of endocrown restorations presents the advantage of reducing the interfaces of the restorative system. Materials with mechanical properties similar to those of sound teeth improve the reliability of the restorative system. The ongoing research for biocompatible materials with physico-mechanical properties similar to those of natural tooth tissues has introduced a new generation of composite blocks for CAD/CAM processing[9].

A major production requirement is accuracy since the accuracy of fit of dental restorations appears to be a major factor for the long-term survival of such restorations [23]. Poor internal fit of a restoration can increase the thickness of the cement and thus influence the mechanical stability of restoration [24,25]. Traditional cast restorations are completely handmade whereas with the CAD/CAM technologies many production steps are virtual and applied through design software [26].

Increase in cement thickness may have a significant influence on structural durability of all-ceramic crowns .Additionally, axial wall cement space can influence the retention of fixed prostheses, with too thick of cementation space reported to reduce retention.[27,28]. Gaps of up to 150 um are suggested and commonly considered as being clinically tolerable [29]. However, the thickness of the cement layer should be as uniform and as thin as possible [30].

The CAD/CAM technology together with the newly introduced materials provided us with a new technique for restoring endodontically treated teeth; a restoration, whose accuracy and success needs to be evaluated and studied.

Review of Literature

Review of Literature

The rehabilitation of severely damaged coronal hard tissue and endodontically treated teeth is always a challenge in reconstructive dentistry. Clinical concepts regarding the restoration of non-vital teeth are controversial and are based on profuse and inconclusive empirical literature [(31).]

A persistent problem in clinical dentistry is represented by the risk fracture of endodontically treated teeth [(32).] These teeth are considered to be less resistant to fracture, because of the loss of tooth structure during conservative access cavity preparation. The influence of subsequent canal instrumentation and obturation leads to a reduction in the resistance to fracture [(33,34).]

It is important to understand the effects of endodontic treatment and various restorative approaches on the tooth structure.

The major changes following endodontic treatment include the following:

<u>Loss of tooth structure:</u>

The decreased strength seen in endodontically treated teeth is primarily because of the loss of coronal tooth structure; it is not a direct result of the endodontic treatment. Endodontic access into the pulp chamber destroys the structural integrity provided by the coronal dentin of the pulpal roof and allows greater flexing of the tooth under function. In cases with significantly reduced remaining tooth structure, normal functional forces may fracture undermined cusps or fracture the tooth in the area of the smallest circumference, frequently at the CEJ [35, 36].

Altered physical characteristic:

The tooth structure remaining after endodontic therapy also exhibits irreversibly altered physical properties. Changes in collagen cross-linking and dehydration of the dentin result in a 14% reduction in strength and toughness of endodontically treated molars. The combined loss of structural integrity, loss of moisture, and loss of dentin toughness compromise endodontically treated teeth so special care require in their restoration [36]

Altered esthetic characteristics:

Esthetic changes also occur in endodontically treated teeth. Biochemically altered dentin modifies light refraction through the tooth and modifies its appearance. Inadequate endodontic cleaning and shaping of the coronal area, medicaments used in dental treatment and remnants of root canal-filling can affect the appearance of endodontically treated teeth [36].

Endodontically treated anterior teeth

The direction of forces exerted on anterior teeth is different than that exerted on posterior teeth; the anterior teeth are placed at an angle to the occlusal plane; the forces are therefore not directed along their long axis. This makes the teeth susceptible to fracture when an unfavorable directional load is applied. The magnitude and the angle of incisal load greatly influence the long-term success of restorative