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

Thesis

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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

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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