Assessment of Fracture Strength of Endocrowns Using Different Ceramic Materials And Preparation Designs

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Dedication

This work is dedicated to

My dear parents,

Precious sister and brother and

My Beloved wife and daughter

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INTRODUCTION

The main reason for performing an endo treatment therapy is preserving the remaining healthy tooth structure after removal of decayed structure or after tooth trauma. Unfortunately, this devitalization procedure leaves the remaining teeth more susceptible to biomechanical failure because of the discontinuation of the structural integrity from access preparation.[(2)]

It has been recently a challenge through decades to choose the best treatment option for the endodontically treated teeth. Using a post or not was the first challenge for these teeth then a new obstacle was there regarding choosing the type of the post whether a metallic or non-metallic one and then choosing its design. Unfortunately using the post and core system need a specific requirement that must be fulfilled in order to assure its success including adequate occlusal space, at least 2mm ferrule must exist and straight canals for the safe placement of the posts. The existence of the required criteria could be assured in most of the cases leaving us with no other treatment option other than having a tooth with questionable durability.

Recently with the appearance of the newest monoblock treatment option providing us with enough adhesion power for the suitable durability in addition to sparing us the hazards of the post systems: root perforation, canal transportation and post irretrievability moreover

relieving us the necessity of the straight canals, ferrule design and enough inter-occlusal space.

The endocrown is a "one-piece ceramic construction comprising a circumferential butt margin and a central retention cavity inside the pulp chamber and constructs both the crown and core as a single unit". The main advantages of such approach are utilizing the available surface in the pulp chamber to improve retention through adhesive bonding in addition to conservatism by following the concept of decay-orientated design.[3, 4]

Endocrowns are a reliable alternative to post-retained restorations for molars and seem promising for premolars.[5] Different preparation designs and ceramic materials should to be tested to be a reliable definitive restoration for premolars before intraoral use.

REVIEW OF LITERATURE

It has been proved and confirmed that a good coronal seal had the most important impact on the final success of endodontically treated teeth. The importance of the procedures carried out after endo-treatment is mainly summarized in its prevention of passage of bacterial microorganisms and its by-products into the apical region of the root and the alveolar bone causing serious delayed failures and affecting the long term endotreatment success.(6)

Ray and Trope (1995)[7], explained the correlation between the coronal and the apical seal showing that 91.4% success rate accompanied with a perfect coronal and apical seal and 67.6% success with only a good coronal seal and a poor apical seal in contrast to only 18.1% success rate followed by a poor coronal and a good apical seal, confirming the important effect of the coronal seal on the periapical health which was also confirmed in similar studies.[8, 9]

Comparison of vital and non-vital teeth in terms of moisture level, mechanical and physical properties of dentin as modulus of elasticity, microhardness and fracture resistance appeared to have moderate to none difference at all in contrast to the loss of tooth structure during access cavity preparation , caries removal, root canal enlargement and trauma which significantly reduce the tooth strength showing the critical role of conservative tooth preparation and leaving as much intact tooth structure

as possible raising the endo treated teeth fracture resistance and the biomechanical behaviour.[10]

Polesel (2014) [11]summarized the different prosthetic treatment options in correlation to the amount of remaining tooth structure as:1) direct adhesive restorations in cases on minimal tooth structure loss for examples healthy tooth structure loss in molars confined to access preparation only.[12] In medium sized cavity bonded indirect restoration as onlay or overlay allow more conservative mean of treatment to prevent further sacrifice of healthy tooth structure offering a better coronal seal. Onlay restoration is used when one marginal ridge is lost and two compromised cusps are found which is frequently found in a single interproximal decay in molar teeth. When both marginal ridges are lost and compromised cusps need to be covered an overlay adhesive restorations are need to protect the remaining toot structure.[11] Although the normal full coverage preparation is considered the gold standard with six times better success rate for restoring endo treated teeth, a more conservative preparation as the adhesives overlay requires removal of teeth structure 50% less than the normal full coverage preparation so increasing the amount of remaining tooth structure and hence the long term service of this tooth.[13] Nowadays indications for ordinary full coverage crown is indicated in fewer situations as severe coronal teeth structure loss especially in the cervical area, being a part in fixed prosthesis or in periprosthetic.[11] The least favourable condition is when

most of the tooth structure is lost from a decay or a traumatic condition. An orthodontic extrusion or an extensive surgical crown lengthening to gain a sound ferrule is not always a feasible line of treatment, pushing us toward extraction or dental implants.(14)

A theory was just proposed once that loss of tactile sensation in endo-treated teeth is the cause of a higher fracture risk in endo treated teeth in comparison to vital one, Schneider et al confirmed that it's a false assumption with no confirmation at all and that vital and non-vital teeth have comparable threshold for tactile sensitivity. Moreover they confirmed that the main cause of the higher fracture risk in endo treated teeth is the amount of tooth structure lost in the access preparation or the decay removal.(15)

When endo treatment is inevitable, the success or failure of endo treated teeth depend mainly on the adequate root canal treatment followed quickly by a strong proper coronal seal restoration.(16) The main reason for restoring an endo treated teeth is the correction of aesthetics and function and preventing any biomechanical failure(11). As mentioned before by Ray and Trope1in 1995, a quickly and properly coronal seal greatly affect the long term success of the endo treated teeth.(7)

Prefabricated posts use was increasingly more popular through the past years. Innovation in their materials of construction and their flexibility is the main innovation nowadays. It has been classified into

metal, ceramic and fibre posts. Composite core bonded to prefabricated glass fibre post giving us a monoblock effect have been accompanied with a dramatic decrease in the catastrophic fracture associated with the custom made post and core.[17]

Dentists used to believe that endotreated teeth are weaker than vital ones and need posts to strengthen them against fracture during chewing. **Asmussin et al** in 2005 [18]confirmed that is not true in all situations, showing that finite element analysis(FEM) studies suggested that bonded posts and parallel ones produces less stresses than non-bonded and taper posts. In addition most studies confirmed that posts have no strengthening effect but may have harmful one if not properly placed.[19, 20]

In certain situations, a post cemented to the radicular dentin is the only way we can have a retentive restoration bonded to the remaining tooth structure, in this situation a fibre post with properties similar to dentin will be used and an adhesive composite resin restoration will be used rendering us the most favourable outcome.[21, 22]

Over the past three decades, the evolution of adhesive restoration and various adhesive systems helps saving the remaining healthy tooth structure and eliminates the use of the ordinary post systems. The appearance of new ceramic materials with a reliable bonding power provokes the idea new decay oriented preparation techniques like the