

INFLUENCE OF PREPARATION TYPE FOR ENDOCROWNS IN ENDODONTICALLY TREATED PREMOLARS

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ABSTRACT

Endocrowns are crowns anchored in the pulp chamber in the cervical region of the root and do not require intraradicular preparation. An easy-to-perform technique, it demands less clinical time compared to traditional single crowns with posts and cores. The objective of this work was to evaluate the influence of the presence of a ferrule and preparation extension on the biomechanical behavior of endodontically treated premolars. The study factors were: 1. presence of ferrule (with or without) and 2. extension of the preparation for the endocrown (2, 3, and 4mm). The response variables were: Maximum principal stress (σ_{max}) and von Mises stress for all structures involved. Models with a ferrule and 2 mm presented the highest values. When observing the compression stresses, it was found that the highest stress values were found in models with a ferrule of 2 and 4 mm. When evaluating the compression stress on the crown, a smaller difference between the groups was found, with the highest values occurring in models without a ferrule. For tensile stresses, the different preparation heights for the endocrown did not affect the results on the crown and root. For compression stresses, the different preparation heights for the endocrown did not affect the results on the crown and root, and for both teeth with and without a ferrule, the highest stress values were found in the 4 mm preparations. Within the limitations of an *in silico* study, it can be concluded that for tensile stresses, the different preparation heights for the endocrown do not affect the stress concentrations on the crown and root.

Keywords: Endodontically treated tooth; *Endocrown*; Ceramic restoration.

INTRODUCTION

The restoration of endodontically treated teeth remains a challenge. Devitalized teeth present a higher risk of fracture than vital teeth (JULOSKI *et al.*, 2012; TORBJÖRNER; FRANSSON, 2003, 2004), since the stress induced on the tooth is directly proportional to the fracture resistance and volume of the remaining dental structure (EGILMEZ *et al.*, 2012). After endodontic treatment, the tooth's

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architecture is modified as a result of the removal of carious tissue, access, and instrumentation in the root canal; thus, the stresses induced on endodontically treated teeth can be more harmful than on vital teeth.

Intracanal posts and cores are necessary to improve the retention and resistance of coronal restorations. Initially, it was believed that this procedure would provide reinforcement of the remaining dental structure. However, it was observed that the use of intracanal retainers only promoted the retention of the prosthetic crown (SOARES *et al.*, 2007).

With the advent of adhesive dentistry, it became acceptable to restore teeth with extensive coronal destruction by performing restorations without the use of intracanal posts, using the entire extent of the pulp chamber as a retention area (BINDL; MÖRMANN, 1999; ZAROW, M *et al.*, 2018; ZAROW, MACIEJ; DEVOTO; SARACINELLI, 2009). Pissis (PISSIS, 1995) was the precursor of this technique, describing it as the "monoblock porcelain technique".

The nomenclature "*endocrown*" was first described by Bindl and Mormann in 1999 (BINDL; MÖRMANN, 1999) as adhesive endodontic crowns, and characterized them as full porcelain crowns for devitalized posterior teeth. These crowns were anchored in the internal part of the pulp chamber and on the cavity margins, thus obtaining the mechanical retention provided by the root canal walls and with the use of cementation. This technique is easy to perform, demands less clinical time compared to conventional crowns, has a lower cost due to the fewer steps involved, and has good aesthetic acceptance (DIETSCHI *et al.*, 2008).

The objective of the work is to evaluate the stress distribution in endodontically treated premolars with or without a ferrule and restored with different preparation heights in endocrowns, to avoid fractures in the roots, leading to the loss of the dental element.

METHODOLOGY

For the *in silico* study, three-dimensional models of a lower premolar with endodontic treatment and preparation for a full crown were used. The study factors were: presence of a ferrule (with or without) and extension of the preparation for the endocrown (2, 3, and 4mm). The response variables were: Maximum principal stress

(σ_{max}) for all structures involved. Using the graphic design program SolidWorks (SOLIDWORKS 2013, SOLIDWORKS CORPORATION, MA, USA) and the three-dimensional model of the premolar, the geometric model of a tooth with endodontic treatment and preparation for a full crown was created. For the geometric model of the mandible, it was made using average measurements of a dentate mandible. The models created in the SolidWorks 2013 program (SolidWorks Corp., Concord, MA, USA) were exported to the finite element program Ansys Workbench 14.0 (Swanson Analysis Inc., Houston, PA, USA) in .igs format (*Initial Graphics Exchange Specification*) for numerical analysis. The mechanical properties of all structures were those available in the specific literature. The mesh was generated using tetrahedral elements with a size of 0.5 mm. The loading was applied obliquely (45°) on the buccal cusp with a force of 250N, simulating lateral movements. The response variables were the maximum principal stress (σ_{max}) for all studied structures.

RESULTS

The models were evaluated both qualitatively and quantitatively. For tensile stresses, no significant differences were observed between the groups. Models with a ferrule and 2 mm presented the highest values. When observing the compression stresses, it was found that the highest stress values were found in models with a ferrule of 2 and 4 mm. When evaluating the compression stress on the crown, a smaller difference between the groups was found, with the highest values occurring in models without a ferrule. For tensile stresses, the different preparation heights for the endocrown did not affect the results on the crown and root. For compression stresses, the different preparation heights for the endocrown did not affect the results on the crown and root, and for both teeth with and without a ferrule, the highest stress values were found in the 4 mm preparations.

CONCLUSION

Within the limitations of an in silico study, it can be concluded that for tensile stresses, the different preparation heights for the endocrown do not affect the stress concentrations on the crown and root.

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