INFLUENCE OF ENDOCROWN PREPARATION IN ENDODONTIC TREATED PREMOLARS

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ABSTRACT

Endocrowns are anchored in the pulp chamber in the cervical region of the root and do not require intraradicular preparation. This technique is easy to perform and requires less clinical time when compared to traditional single crowns with posts and cores. The objective of this study was to evaluate the influence of the presence of the ferrule and the preparation length on the biomechanical behavior of endodontically treated premolars. The study factors were: 1. presence of ferrule (with or without) and 2. preparation length for Endocrown (2, 3, and 4 mm). The response variables were: Maximum principal stress (σmax) Mises for all structures involved. The models with a 2 mm ferrule presented the highest values. When observing the compressive stresses, it was found that the highest stress values were found in the models with a 2- and 4-mm ferrule. When evaluating the compressive stress in the crown, there was a smaller difference between the groups, with the highest values occurring in the models without a ferrule. In tensile stresses, the different preparation heights for the Endocrown do not affect the results in the crown and root. In compressive stresses, the different preparation heights for Endocrown do not affect the results in 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 the tensile stresses at the different preparation heights for Endocrown do not affect the stress concentrations in the crown and root.

Keywords: Endodontically treated tooth; Endocrown; Ceramic restoration.

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INTRODUCTION

The restoration of endodontically treated teeth remains a challenge. Pulped teeth have a higher risk of fracture than vital teeth (JULOSKI et al., 2012; TORBJÖRNER; FRANSSON, 2003, 2004), since the stress induced in 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 architecture is modified due to the removal of decayed tissue and access and instrumentation in the root canal. Therefore, the stresses induced in the endodontically treated tooth may be more harmful than in the vital tooth.

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, and using the entire length 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 “monobloc porcelain technique”. The nomenclature “endocrown” was first described by Bindl and Mormann in 1999 (BINDL; MÖRMANN, 1999) as adhesive endodontic crowns, and characterized it as total porcelain crowns for posterior pulpless teeth. These crowns were anchored to the inside of the pulp chamber and to the margins of the cavity, thus obtaining the mechanical retention provided by the walls of the root canal and using cementation. This technique is easy to perform, requires less clinical time when compared to conventional crowns, is less expensive due to the fewer steps involved, and has good aesthetic acceptance (DIETSCHI et al., 2008).

The objective of the study is to evaluate the distribution of stresses in endodontically treated premolars with or without a ferrule and restored with different preparation heights in endocrowns, to avoid root fractures that lead to tooth loss.

METHODOLOGY

To perform 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 length of preparation for the endocrown (2, 3, and 4 mm). The response variables were maximum principal stress (σmax) 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. The geometric model of the mandible 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 the .igs (Initial Graphics Exchange Specification) format 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 load was applied obliquely (45º) to the buccal cusp with 250 N of force, simulating lateral movements. The response variables were the maximum principal stress (σmax) for all structures studied.

RESULTS

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

root results; the highest stress values were found in the 4 mm preparations for both teeth with and without a ferrule.

CONCLUSION

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

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