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Research paper

Influence of occlusal geometry on ceramic crown fracture; role of cusp angle and fissure radius

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ABSTRACT

Objectives

To develop an approximate analytical model that identifies the influence of both cusp angle and notch radius on the failure load of all-ceramic premolar crowns.

Methods

The scatter of failure loads in a crown fracture resistance test was analyzed based on the stress intensity and stress concentration factors from mechanics models developed for simple compact tension to more sophisticated blunt V-notch specimens. Based on the same loading conditions and dimensions, the predicted loads were systematically compared with fracture loads of laboratory-tested crowns to identify the most relevant model. Finally, based upon these models a safe range of cusp angles and notch radii were identified for posterior all-ceramic crowns with various veneering materials' fracture toughness values as the selection criteria.

Results

The failure loads of the crowns were distributed in the range between the classical compact tension (lower bound) and blunt V-notch model (upper bound). Additionally, when considering the effect of different materials, the predicted trend of failure loads moves to higher loads well above typical occlusal forces when the fracture toughness of veneering porcelain is increased. The effects of notch radius on the failure load are still inconclusive due to the relatively complex shape of occlusal surfaces. Further studies on crowns with a range of material properties are required to substantiate the model.

Significance

Cusp angle is a key factor that controls the stress generated at the crown fissure. This study provides the rationale for evaluating such effects and clinical guidelines for occlusal design are proposed.

1. Introduction

Aesthetic all-ceramic materials are the first choice in restorative dentistry used for the anterior and to an increasing extent the posterior region. For decades a great deal of research has been done on this class of materials to develop and generate different restorative treatments (see for instance reviews by Kelly (1997) and Kelly et al.

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