Short communication

Glass ionomer layer thickness and its influence on zirconia failure

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ARTICLE INFO

Article history:
Received 28 April 2011
Received in revised form 10 May 2011
Accepted 11 May 2011
Published online 17 May 2011

Keywords:
Zirconia
Fracture resistance
Cement layer thickness
Luting agent
Glass ionomer
Flexural radial fracture

ABSTRACT

Objectives: To investigate the influence of glass ionomer cement layers with various thickness and cement contamination on the fracture resistance of thin zirconia plates luted onto coplanar human molars.

Materials and methods: Zirconia plates measuring 0.7 mm in thickness were luted onto 70 coplanarly trimmed human molars with glass ionomer cement. Cement layers measuring 100, 250, 1000, and 2000 µm in thickness were produced. Contamination of the tooth surface was achieved by applying hand-piece oil, contamination of the cement by mixing glass ionomer with H2O2 to produce voids and gas bubbles.

Results: Fracture resistance was independent from cement layer thickness (median ranging from 1220 to 1367 N). Oil contamination moderately reduced fracture resistance (1135 N). Fracture resistance was significantly affected by the presence of a considerable amount of voids or gas bubbles in the cement (877 N).

Conclusions: The fracture resistance of thin zirconia plates was not affected by different cement layer thickness but by contamination of the tooth surface as well as by high cement porosity due to simulated handling errors.

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1. Introduction

Failure of all-ceramic reconstructions may be glass–cone cracking, quasi-plastic yield, or flexural radial cracking. Fine-grain glass ceramics mainly show glass–cone cracking, whereas coarse-grain glass ceramics and structural ceramics, such as alumina or zirconia, often show quasi-plastic yield (Thompson and Rekow, 2004). In thick ceramics, bulk properties dominate. If, for example, the wall of a ceramic coping is considerably thicker than 1 mm, then its fracture behavior will be more influenced by its bulk property (Molin et al., 1996; Thompson and Rekow, 2004), i.e. the typical mode of failure will be glass–cone cracking or quasi-plastic yield. In this case, the failure load depends on the radius of the indenter, which is clinically a cusp of tooth. However, in ceramics measuring less than 1 mm in thickness, flexural radial cracking predominates. The failure load becomes independent from the indenter radius; now the stiffness of the underlying structures, such as the cement layer, plays a role in the load, causing the failure. For a bi-layer system consisting of ceramic and underlying substrate, the failure load \( L_f \) can be calculated with the formula (Lawn et al., 1975-1981).