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Contact Damage of Model Dental Multilayers: Experiments and Finite Element Simulations

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Abstract

This paper presents an overview of recent studies of contact damage in multilayered structures with equivalent elastic properties to bonded dentin/crown structures. Following a brief review of restored tooth structures, prior work on the development of model dental multilayered structures is reviewed. The review examines the two sides of the current debate on the applicability of Hertzian indentation tests to real clinical scenarios. In particular, the potential effects of indentation ball size are identified as some of the reasons for the "apparent" discrepancies in the literature. An experimental framework is then presented for the exploration of the effects of ball size on contact damage mechanisms in dental multilayers. The observed cracking patterns at the onset of crack nucleation are shown to be associated with principal stress contours computed using elastic-plastic finite element models. The statistical variations in the crack nucleation loads are shown to be well described by Weibull (weakest link) statistics. The implications of the results are discussed for the design of dental multilayers that are more resistant to crack nucleation and propagation.