# Fracture parameters evaluation for cracked nonhomogeneous enamel based on nonhomogeneous finite element method and virtual crack closure technique

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### Abstract

To solve the fracture parameters of enamel accurately, we established computational nonhomogeneous enamel models and constructed the fracture element of enamel dumb nodes, based on enamel mineral concentration, nonhomogeneous mechanical properties, and nonhomogeneous finite element method. We constructed the user subroutines UMAT and UEL in ABAQUS to solve the energy release rates of nonhomogeneous enamel structure with cracks. The stress intensity factors of central cracks, three-point bend and compact stretched enamels, double-edge notched stretched enamels and kink notched stretched enamels were determined. By comparing with analytical solutions, we proved the fracture element of enamel dumb nodes is highly accurate, simple and convenient, and the cracks can be other elements rather than singular or special elements, and show versatility and other advantages. The stress intensity factor of dental enamel can be solved more realistically. Thus, a new numerical method for prevention and treatment of dental diseases is provided.

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