On the Fracture Toughness and R-Curve Behavior of Human Enamel

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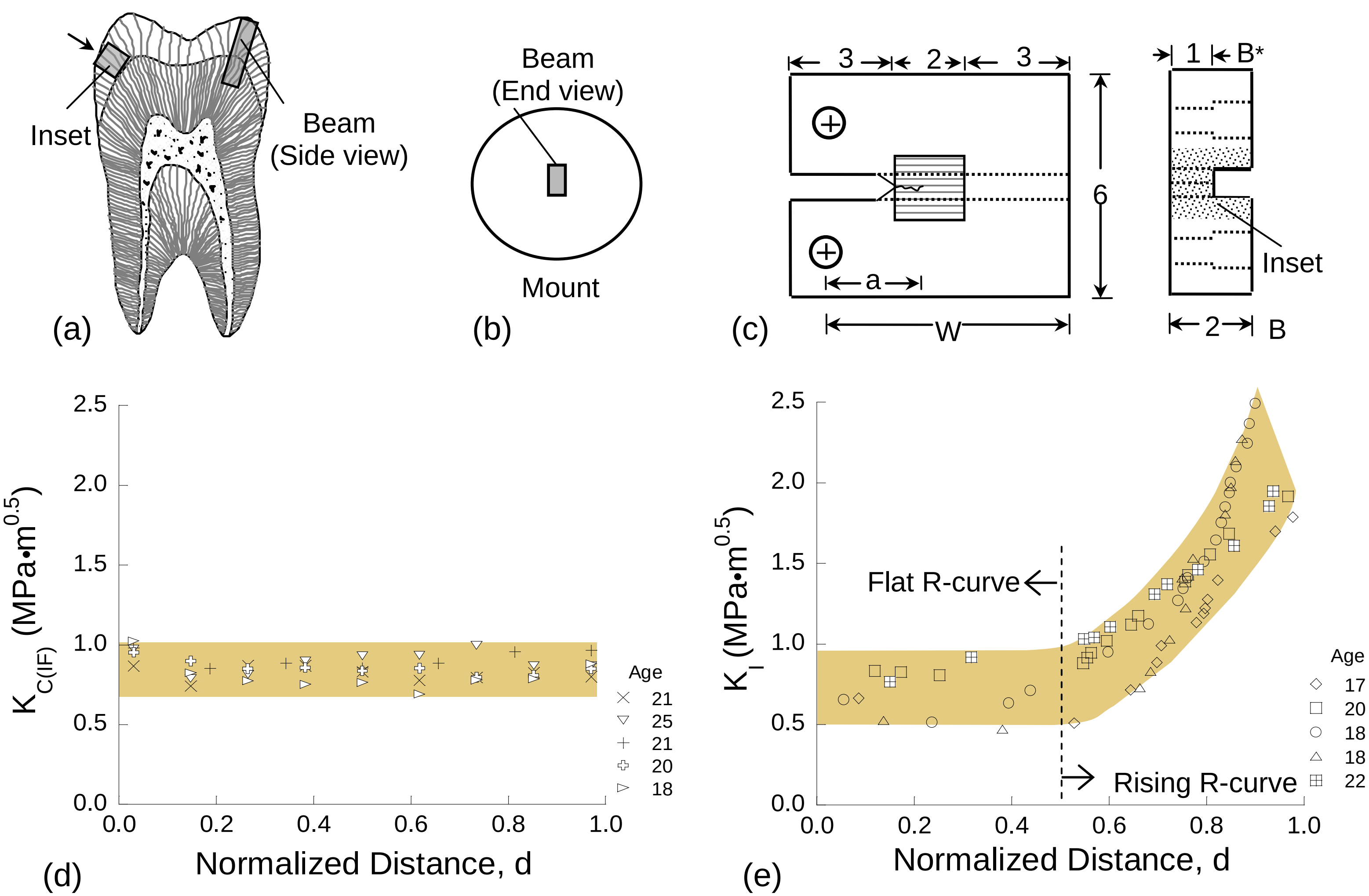

Figure. Schematic diagram of specimen configurations and the toughness distribution of human enamel obtained using the indentation and the monotonic crack growth method. (a) A molar sectioned bucco-lingually depicting the microindentation beam section and the inset for the CT specimen. The arrow indicates the direction of crack growth in the inset of the CT specimen. (b) Microindentation specimen. The cuspal beams were mounted in cold-cure epoxy such that the occlusal surface faced outward and the enamel prisms were oriented perpendicular to the potting surface (parallel to the axis of indentation). (c) The inset CT specimen. The tissue is embodied within a dental composite resin and the direction of crack growth is along the direction of enamel prisms. (d) Indentation fracture resistance ($K_{C(IF)}$) exhibited a linear trend with no significant difference in the toughness between the outer and the inner enamel. Note that the normalized scale identifies distance from the outer enamel (0) to the DEJ (1) equivalently for all teeth, regardless of anatomical differences. (e) Incremental crack growth distinguished a rising R-curve behavior with the rise in toughness associated with crack growth in the inner half of the enamel. A comparison of the two techniques suggests that the indentation fracture technique is unable to quantify important contributions of the microstructure to the toughening behavior of enamel.

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