Tooth Fracture Studies
Lead to Longer Lasting Teeth

The Challenge:

Determine the Fracture Properties of Dentin in Restored Teeth

Background

Recent examination of restored molars suggests that cyclic crack growth may contribute to a greater understanding of restored tooth fracture. It was found that molars with typical amalgam restoration could experience cusp fracture within twenty-five years if flaws greater than 25 µm were introduced into the margin of the restored area during restoration. This could explain the greater likelihood for restored tooth failure in comparison to untreated teeth.

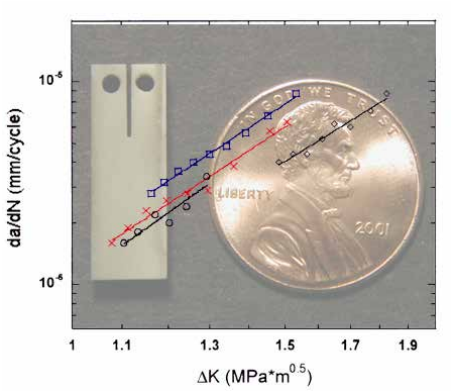
Tooth fractures originating at the boundary of a repair may indicate the presence of cyclic crack growth

While it is possible that the rate of fracture occurrence following restoration may be dependent on the type of material that is used for initial repairs (i.e., reinforcement through composite or amalgam), study results suggest that the failure rates are similar for both materials. Some contend that this is the result of the method of tooth preparation rather than restorative material. Past in vitro studies involving the rate of tooth fracture are limited as they use only monotonic loads, ignoring the cyclic nature of mechanical and thermal stresses during typical oral activities.

Meeting the Challenge

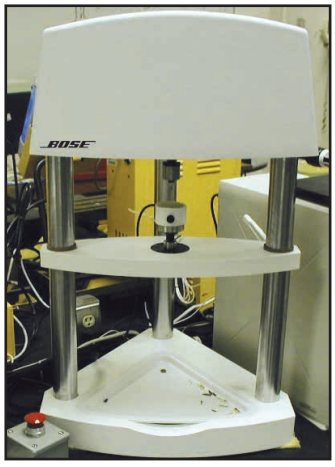
Fresh molars were harvested from young calves and sectioned along the mesial/distal axis of the crown. Elongated Compact Tension (CT) specimens were machined from the crown sections to produce dentin specimens. The longitudinal groove was introduced to channel the direction of cyclic crack growth during loading.

All specimens were prepared under a water-based flood coolant. The fatigue crack growth rate was estimated from crack length measurements conducted after specific intervals of loading. The expected crack path was accentuated with silver nitrate to heighten contrast between the crack and dentin, and the crack length was measured through visual observation using a scaled optical microscope (60X).



Results

Using the ElectroForce® 3200 test instrument, Dr. Dwayne Arola's group at the University of Maryland, Baltimore County has shown that fatigue crack growth exponent tested at a load frequency of 5 Hz was found to range from 3.7 to 4.3 for crack growth in-plane with the dentinal tubules. This falls right in-between the range published for bone (2.8-5.1).



Summary

Although results are preliminary, this study and similar ones, will help guide researchers in producing new materials and methods for longer-lasting restorations.

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