## COMMENTARY

# Evaluation of Fracture Resistance and Failure Risks of Posterior Partial Coverage Restorations[1]

**TERRY E. DONOVAN,** DDS*

Drs. Kois, Chaiyabutr, and Kois, and Mr. Isvilanonda are to be congratulated for their timely in vitro study comparing the fracture resistance of contemporary materials that have been advocated as materials suitable for partial coverage restorations on posterior teeth.[1] Many contemporary ceramic materials are being marketed aggressively with little or no scientific evidence behind them, so this information is significant for clinicians.

The study compared feldspathic ceramic onlays with leucite- and lithium disilicate-reinforced ceramic onlays, and onlays fabricated with laboratory-processed composite resin. Extracted molars were prepared with a unique standardized preparation design, reducing the inner cuspal inclines a depth of 2 mm. Although this specific design would not likely be used clinically, it did allow for careful standardization of the preparations for comparative purposes. The leucite-reinforced and lithium disilicate-reinforced restorations were pressed, allowing for reduction in inherent defects, and the feldspathic restorations were hand-fabricated with typical condensation techniques.

The sample size (15) and bonding protocols and statistical analysis used were appropriate. Fracture resistance was determined using a load-to-failure protocol. A finite element analysis (FEA) was done to evaluate the maximum principal stress with each type of restoration under a 100-N static vertical compression at the occlusal surface.

The study found that the lithium disilicate material had significantly higher fracture resistance than the other materials. The leucite-reinforced material had higher fracture resistance than the feldspathic porcelain and composite resin materials, which had essentially equivalent fracture resistance. However, 73% of the composite resin onlays demonstrated extensive fractures involving both the tooth and root structures, whereas the ceramic materials mostly demonstrated fracture in the material itself, leaving the prepared tooth intact. Based on the load-to-failure testing, the authors concluded that the lithium disilicate material was the material of choice. This conclusion was supported by data from that FEA that found that the lithium disilicate material had the lowest risk for failure.

The primary weakness in this study is the load-to-failure protocol. It is important to understand that both restorative materials and teeth fail as a result of occlusal stresses that are too small to induce spontaneous fracture. These stresses result in inherent defect propagation over time and tooth/restoration failure by fatigue. The most clinically relevant in vitro studies involving ceramic materials involve fatigue testing under water, as ceramics fail at much lower loads underwater than in air. To their credit, the authors recognized this but felt that the high costs of sample preparation and time related to fatigue testing might be restrictive. This is certainly true, but the strength and clinical significance of the conclusions are reduced as a result of using the load-to-failure protocol.

The study might also have been improved by artificially aging the samples prior to loading. With 2 mm of occlusal reduction, a significant amount of dentin would be exposed, and long-term success would be dependent on the stability of the dentin bond.

**Professor and Section Head for Biomaterials, Department of Operative Dentistry, University of North Carolina School of Dentistry at Chapel Hill, Chapel Hill, NC 27599-7450, USA*

This commentary is accompanied by article, "Evaluation of Fracture Resistance and Failure Risks of Posterior Partial Coverage Restorations," Dean E. Kois, DMD, MSD, Vara Isvilanonda, BEng, MSME, Yada Chaiyabutr, DDS, MSD, DSc, John C. Kois, DMD, MSD, DOI 10.1111/jerd.12018.

 *DOI 10.1111/jerd.12019*

Readers of the study should also understand that the lithium disilicate material used was monolithic rather than layered. Most of the published data on this product, which is generally quite favorable, relates to the monolithic form. That form, which is generally stronger but less esthetic than the layered form, is perfectly suitable for the restorations used in this study. To obtain excellent esthetic results with indirect restorations on anterior teeth, layered restorations are preferred. The data produced in this study cannot be extrapolated to layered lithium disilicate restorations.

## REFERENCE

1. Kois DE, Isvilanonda V, Chaiyabutr Y, Kois JC. Evaluation of fracture resistance and failure risks of posterior partial coverage restorations. J Esthet Restor Dent DOI 10.1111/jerd.12018.

 *DOI 10.1111/jerd.12019* 