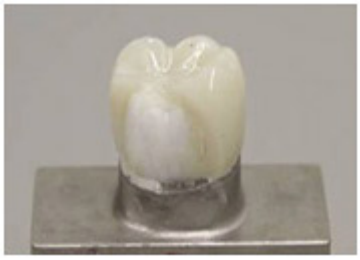
IPS e.max Lithium Disilicate is a high strength ceramic material with 360-400 MPa of flexural strength. When fabricated to full-contour or in a monolithic state, lithium disilicate is an extremely durable material.

Failures in zirconia veneered restorations are the result of a very weak 90 MPa porcelain material having chewing forces exerted upon it. The 1,000 MPa zirconia substructure remains in tact but the failure of the layering porcelain is ultimately a failure of the restoration.

With monolithic lithium disilicate, the work of mastication is being done on a 360-400 MPa material. This strength is homogenous throughout the entire restoration.

Several internal Ivoclar Vivadent tests have demonstrated that the monolithic lithium disilicate is incredibly durable and that the zirconia veneered restorations fail with less load and fewer chewing cycles.

In order to validate these findings, Ivoclar Vivadent called upon the expertise of New York University. The researchers at NYU are authorities on dental materials and have conducted numerous studies investigating the longevity and performance of a wide array of dental materials.



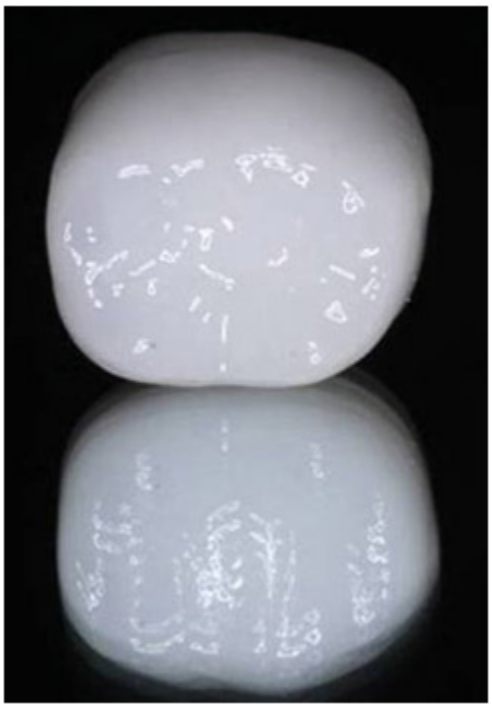
Chipping on Zirconia

Mouth-Motion Cyclic Fatigue Testing

Crown specimens are subjected to mouth-motion cyclic fatigue testing which is able to mimic the forces found while chewing. The test is performed by loading the crown specimens through several thousand cycles at a predetermined load. After being examined for cracks, the specimens are then tested for several thousand more cycles at a higher load. This process is repeated until failure occurs.

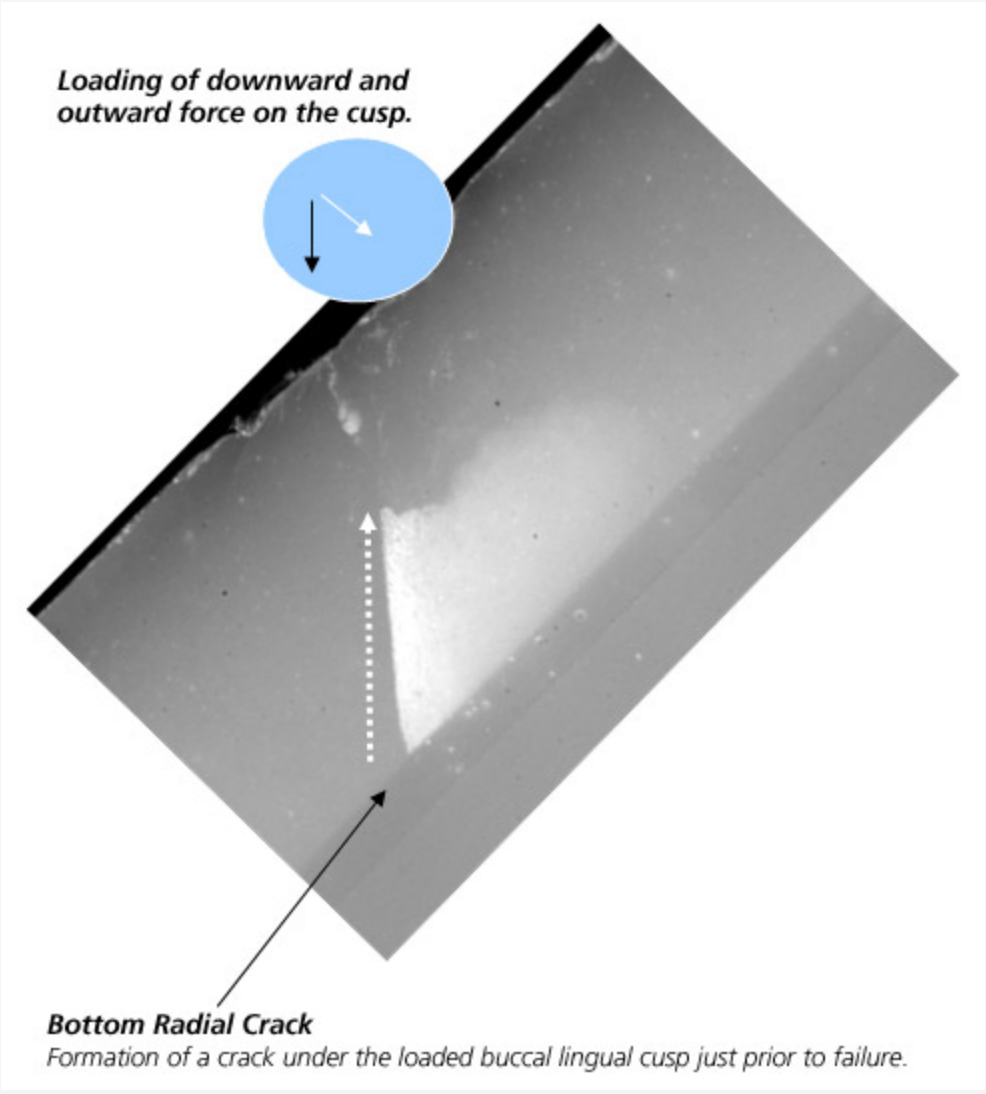
RESTORATIONS TESTED

Layered Porcelain on Zirconia



Monolithic Lithium Disilicate

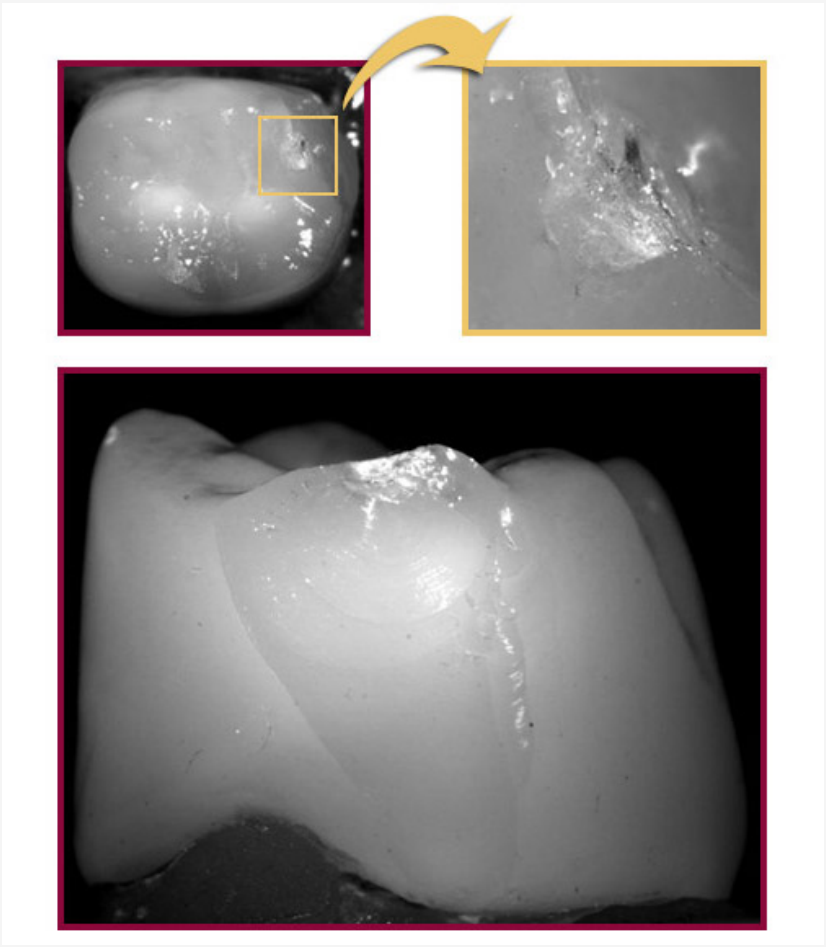
MOUTH-MOTION SIMULATOR



Test results showed that monolithic lithium disilicate outperformed veneered zirconia restorations. Through a 1,000N load and 1,000,000 cycles, none of the lithium disilicate crowns fractured. Only superficial damage in the form of wear facets similar those of natural teeth can be observed.

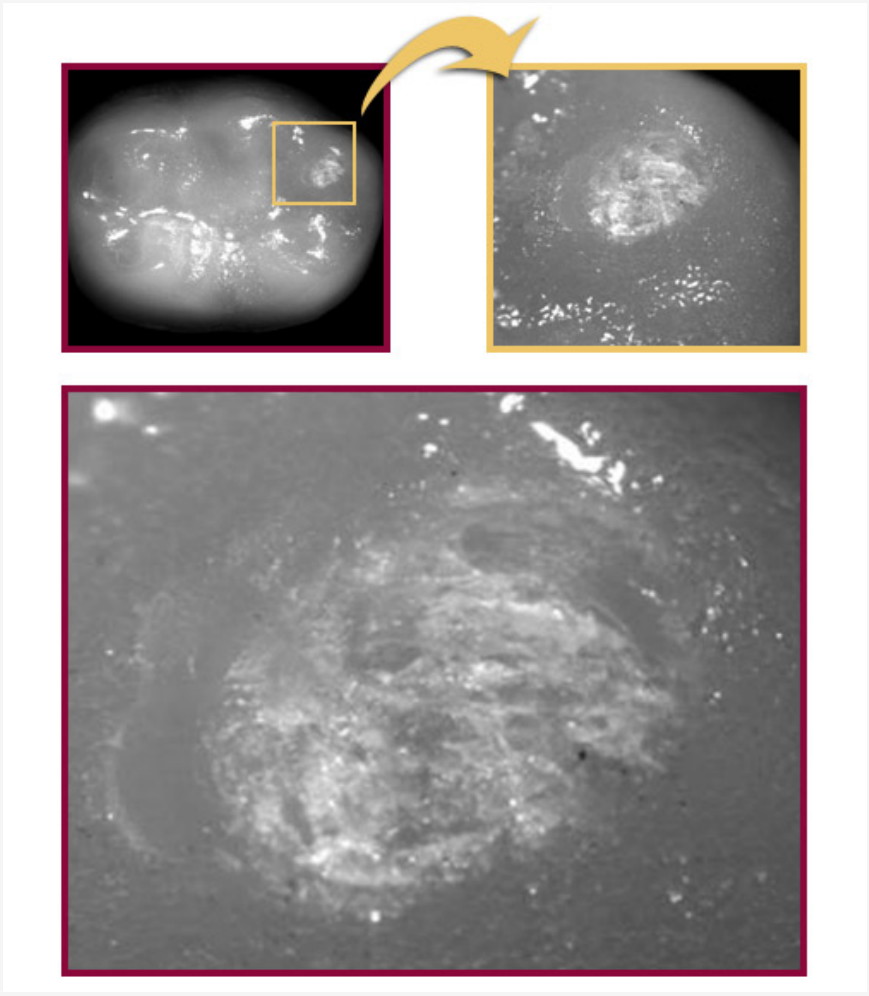
THE RESULTS — LAYERED PORCELAIN ON ZIRCONIA

Example of shear failure of porcelain on a zirconia restorations at 300N and approximately 50k cycles.

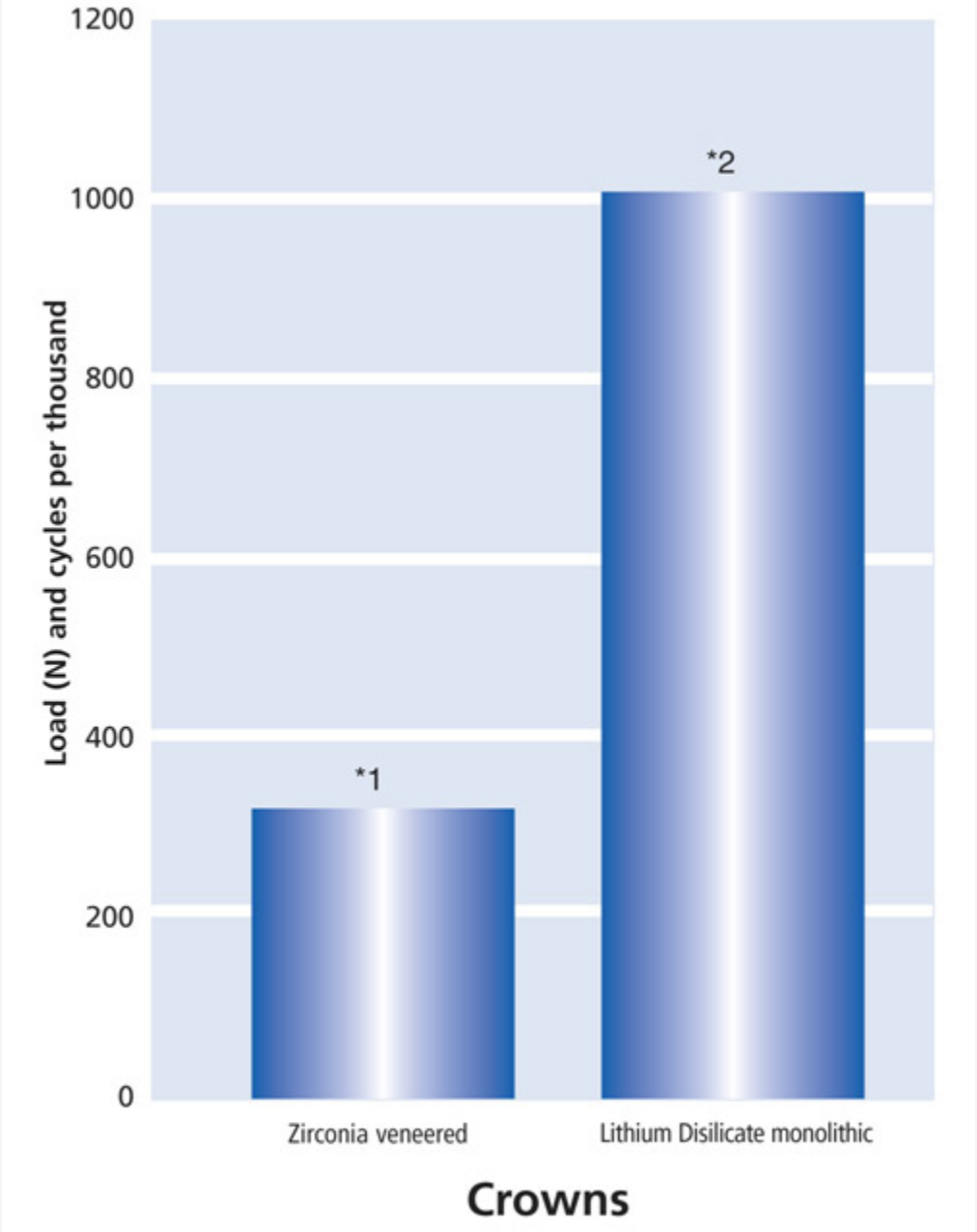


THE RESULTS — MONOLITHIC LITHIUM DISILICATE

No fractures, only superficial damage in the form of wear facets.



MATERIAL SURVIVAL WITH CYCLIC FATIGUE TESTING



* **Mouth Motion Fatigue and Durability Study**
Petra C Guess, Ricardo Zavanelli, Nelson Silva and Van P Thompson, NYU

[1] 90% failure by 100,000 cycles

[2] No failures at 1 million cycles

Mouth Motion Fatigue and Durability Study

Petra C Guess [1], Ricardo Zavanelli [2], Nelson Silva and Van P Thompson, NYU

June 20, 2009

Executive Summary:

- Porcelain veneered zirconia crowns and monolithic lithium disilicate crowns were tested
- Mouth-motion-step-stress-fatigue was used to examine reliability and failure modes
- Failure was considered to be chip-off fractures of veneering ceramic or fracture through the crown
- Three step-stress profiles were used up to failure or up to 900 N and 180K cycles after which a staircase fatigue method was implemented to a load at which 50% of specimens could be expected to survive 1 million cycles
- Veneered zirconia crowns resulted in limited reliability - approximately 90% of specimens would fail from veneer chip-off fracture by 100k cycles at 200 N. These results are similar to previous findings for other veneered zirconia systems (LAVA, Cercon, Vita) tested using this methodology (Coelho PG, Silva NR, Bonfante EA, Guess PC, Rekow ED, Thompson VP. Fatigue testing of two porcelain-zirconia all-ceramic crown systems. Dent Mater. 2009 Apr 21. [Epub ahead of print]
- Approximately 90% veneered zirconia specimens failed by 350 N independent of the number of cycles (Appendix 1)
- None of the e.max CAD lithium disilicate specimens failed below 900 N and 180k cycles independent of loading profile
- The e.max CAD lithium disilicate specimens survived r ratio fatigue of 1 million cycles at loads of 1000 N. There appears to be a threshold for damage/fracture for the lithium disilicate in the range of 1100-1200 N.

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