

Strong NobelProcera® Abutments Science First

Clinical relevance

- **"Manufacturer matters"**: the four abutments look very similar on clinical examination, but differed significantly in performance, indicating the impact of design and production method.
- Engineered, not copied: NobelProcera restorations offer a precise fit, be it on Nobel Biocare or other implant systems.
- Observed failure modes in this study are consistent with those observed clinically.

Scientific evidence

Data from in vitro fatigue testing of four different zirconia CAD/CAM abutments (all mounted on Straumann® Bone Level implants):

- Full zirconia: Straumann® and Atlantis™.
- Zirconia with titanium base: NobelProcera and Glidewell Laboratories.

Study findings

Resistance to failure differed significantly under accelerated loading conditions (150–200 N):

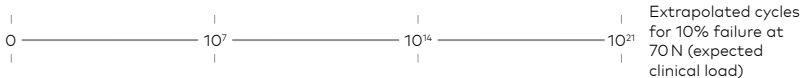
- No NobelProcera Abutment failed.
- All Glidewell abutments failed.
- All Atlantis™ abutments failed.
- 41% of Straumann® abutments failed.

At a clinical load of 70 N, the extrapolated loading cycles for a 10% failure rate are therefore immensely higher for NobelProcera Abutments (sextillion vs million cycles).

Zirconia abutments with titanium base

NobelProcera 1 sextillion cycles
1,000,000,000,000,000,000,000

Glidewell 1 million cycles
1,000,000



Full zirconia abutments

Straumann® 30 million cycles
30,000,000

Atlantis™ 20 million cycles
20,000,000



"Manufacturer matters": resistance to failure differed significantly, indicating the impact of design and production method.

Abstract

Study title

Kelly JR, Rungruanganunt P. Fatigue Behavior of Computer-Aided Design/Computer-Assisted Manufacture Ceramic Abutments as a Function of Design and Ceramics Processing. Int J Oral Maxillofac Implants. 2016;31(3):601-9

Purpose

Zirconia is being widely used, at times apparently by simply copying a metal design into ceramic. Structurally, ceramics are sensitive to both design and processing (fabrication) details. The aim of this work was to examine four computer-aided design/computer-assisted manufacture (CAD/CAM) abutments using a modified International Standards Organization (ISO) implant fatigue protocol to determine performance as a function of design and processing.

Materials and methods

Two full zirconia and two hybrid (Ti-based) abutments (n=12 each) were tested wet at 15 Hz at a variety of loads to failure. Failure probability distributions were examined at each load, and when found to be the same, data from all loads were combined for lifetime analysis from accelerated to clinical conditions.

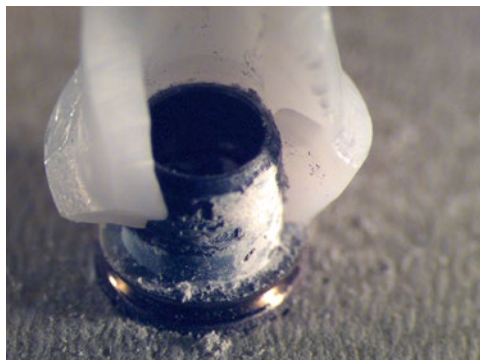
Results

Two distinctly different failure modes were found for both full zirconia and Ti-based abutments. One of these for zirconia has been reported clinically in the literature, and one for the Ti-based abutments has been reported anecdotally. The ISO protocol modification in this study forced failures in the abutments; no implant bodies failed. Extrapolated cycles for 10% failure at 70 N were: full zirconia, Atlantis 2×10^7 and Straumann 3×10^7 ; and Ti-based, Glidewell 1×10^6 and Nobel 1×10^{21} . Under accelerated conditions (200 N), performance differed significantly: Straumann clearly outperformed Astra (t test, $P = .013$), and the Glidewell Ti-base abutment also outperformed Atlantis zirconia at 200 N (Nobel ran-out; t test, $P = .035$).

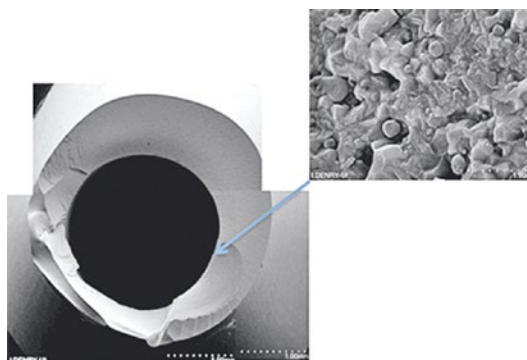
Conclusion

The modified ISO protocol in this study produced failures that were seen clinically. The manufacture matters; differences in design and fabrication that influence performance cannot be discerned clinically.

Impact of design and production method



Glidewell: "For both debonding/fracture and tube tearing, Glidewell parts failed at much lower loads and shorter number of cycles than did Nobel Biocare parts; hence, there must be influential differences in design and/or manufacturing."



Atlantis™: "Machined surfaces (screw seat and screw hole) had a layer of poorly sintered material with considerable porosity to a depth of approximately $5 \mu\text{m}$. This presumably resulted from the manufacturer leaving a layer of machining (or grinding) dust on the surface during final sintering. Such a grinding dust layer would have a very low packing density inhibiting sintering."

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