

# Damping Behavior of Implant-Supported Restorations

Michael Silva

## Background

For normal healthy teeth the percussive energy generated by mastication is attenuated by the periodontal ligament at the healthy bone-natural tooth interface. However when the natural tooth must be replaced by an implant due to damage or disease the ligament is lost and the implant will transmit the percussive forces directly into the bone. To compensate for this loss the use of either composite or zirconia to fabricate the implant abutment has been shown to be effective in numerous studies. While such studies have shown the survivability of implant restorations utilizing composite resin or zirconia abutments there has been no such research done to measure the dynamic response to load of said abutment materials.

## Objectives

A new test methodology was developed to evaluate tooth and implant response to dynamic loading. The Periometer is a percussion probe that measures the energy loss coefficient (LC) and consists of hardware and software that are interfaced to a unique handheld instrument. The purpose of this study was to evaluate the LC of extracted human teeth and assess which type of implant-supported restoration (CAD/CAM composite resin and zirconia abutments combined with composite resin and ceramic onlays and crowns) would respond more biomimetically to physiologically-relevant dynamic loading.

## Methods

One hundred-and-twenty morse taper implants (Titamax CM 11 mm) were mounted on bone-simulating acrylic resin base and restored with CAD/CAM zirconia (60) and composite resin Paradigm MZ100 (60) abutments. Using a CEREC3 machine, standardized onlays (60) and crowns (60) were designed and milled in ceramic (Paradigm C) or composite resin (Paradigm MZ100) to simulate a maxillary premolar. All restorations were luted with a preheated light curing composite resin (Filtek Z100). Fifteen extracted human upper pre-molars were mounted with a simulated PDL (RubberSep) and used as control group. After restoration assembly, the Periometer probe tip was positioned perpendicularly to the buccal surface of each restoration. Three measurements were collected for each specimen. The averaged LC of each group (n=15) was compared using 2 way-ANOVA.

## Results

Differences in loss coefficient between the abutment material (zirconia/Paradigm MZ100) and the restoration material (Paradigm C/Paradigm MZ100) were recorded but not between the restoration design (onlay/crown). The average loss coefficient of zirconia and composite resin abutments ranged from 0.040 to 0.053 and 0.059 to 0.068 respectively. Zirconia abutments restored with composite resin onlays (0.051) had the closest loss coefficient value when compared with the tooth samples (0.049).

## Conclusion

Composite resin onlays bonded to zirconia implant abutments presented the most biomimetic dynamic response to load when compared to teeth in a simulated PDL/bone support structure.