The integrity of the dental implant abutment junction (AIJ) has clinical importance due to the detrimental events associated with an inferior seal. Specifically, it has been demonstrated that a poorly seated AIJ permits contamination of microbes within the implant connection area, leading to leakage issues. 

The loss of significant amounts of hard tissue may decrease the stability of the implant, potentially threatening the long-term success of the implant. 

Specifically, the apex of the implant sample was modified with the goal of creating a surface that prevented the introduction of bacteria into the apical portion of the implant. 

The aforementioned study hypothesized that screw pre-load was a contributing factor to the seal capabilities of the BIOMET 3i implant system. The objective of the current study was to characterize the AIJ seal robustness for an implant system with Titanium and Gold-Tite® abutments, each of which has unique pre-load characteristics.

Methods and Materials

In order to test implant systems, a dynamic loading leakage test was developed and executed. The test setup was performant: a 30 N-force rigid fixture was connected to the implant fixture, and a straight abutment and screw were loosely assembled to the implant. 

The test results, as documented in Figure 6, show that the Gold-Tite screw generated a greater than 50% increase in the seal strength (705 ± 45 vs. 500 ± 41). In no instance did the introduction of the second Titanium screw be unrelated to loosening or loss of pre-load. 

A parametric Mann-Whitney test of medians was utilized to compare the Gold-Tite and Titanium screw groups due to a non-normality in the data. A difference of 30 N-force was considered significant. The statistical analysis showed that P = 0.017 when evaluating these groups. The outcomes of the statistical analysis were consistent with the findings of the study.

The primary load-bearing screw design was tested using a load cell connected to the implant and digital force gauges. After a 4-30 N range of torque, the Gold-Tite screw produced a pre-load of 50 N-force. 

The pre-load for both screw designs was tested using a load cell connected to the implant and digital force gauges. After a 4-30 N range of torque, the Gold-Tite screw produced a pre-load of 50 N-force. 

The use of a high-resolution video camera at 50x magnification to qualify the seal integrity (Figure 5).

The size of the microgap required to permit leakage is dependent upon the media composition intended to be sealed. In general, all matter is made up of molecules and as such the theoretically allowable size of a gap to prevent leakage must be smaller than a molecule (e.g., a water molecule has a maximum diameter of ~0.0002 microns). However, factors such as decreases in the media's molecular density can contribute to their ability to leak material through a microgap.

The seal strength of two-part dental implant systems is a popular topic of study. As such, researchers have developed multiple methodologies to characterize them including:

- Scanning electron microscopy microgap analysis
- Fluid leakage testing
- Microgap leakage analysis

Each of these methodologies has potential limitations in regards to their representation of the clinical scenario.

The post-operative clinical implant system seal performance is a complex process. As such, research has focused on developing new methodologies to characterize them:

- Scanning electron microscopy microgap analysis
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Each of these methodologies has potential limitations in regards to their representation of the clinical scenario.

The authors of the study conducted a series of experiments to evaluate the seal properties of the implant-abutment interface. They reported an average gap diameter of 5.8 μm for the 3i implant system using a Bact-Eye™ Enclosed Abutment with a Gold-Tite screw. As a comparison, in the same study, the width of ferric chloride processes with Procera® Zirconia abutment samples averaged 0.62 microns of marginal gap. 

While SEM analysis using an important analytic tool, a limitation of this methodology is its static, non-loaded nature.

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