ASSOCIATION BETWEEN IMPLANT-ABUTMENT MICROGAP AND IMPLANT CIRCULARITY TO BACTERIAL LEAKAGE: AN IN VITRO STUDY USING TAPERED CONNECTION IMPLANTS

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Abstract

The aim of this study was to evaluate the microgap between the abutment and implant as well as the circularity of implant platforms and associating conformational errors with bacterial micro leakage in tapered connection implant systems.

Four brands of implants with tapered abutment connection were tested. Bacterial leakage was assessed using 0.3 μ L of Escherichia coli suspension inoculated into the abutment screw chamber of the implants, which were then torqued and incubated at 37°C for 14 days. The same samples were then cut lengthwise, and the microgap measured at 3 points on each side using scanning electron microscopy (SEM). Microtomography was used to assess implant platform circularity to validate the SEM findings qualitatively.

All implant Systems presented bacterial leakage, with no significant difference between groups. Neodent system presented the highest mean microgap values, followed by Nobel Biocare, Ankylos and Conexão, with no significant difference between groups. All systems showed conformational errors of circularity on microtomography images.

The tapered connection systems evaluated herein were not able to halt bacterial leakage, nor were free from conformational errors.

Fig.X: SEM micrographs of representative samples from each implant system illustrating the maladaptation gap at the IAI

Fig.2: Bar chart of the mean values and standard deviations of maladaptation (gap) at Implant-abutment interface for the systems tested

Results

Two samples from the Nobel Biocare system, four from the Ankylos system, four from the Neodent system and five from the Conexão system were positive for bacterial leakage, with no significant difference between groups. The Neodent system had the highest mean microgap values ($5.84 \pm 9.83 \mu\text{m}$), followed by Nobel Biocare systems ($5.17 \pm 4.10 \mu\text{m}$) Ankylos ($3.47 \pm 3.28 \mu\text{m}$) and Conexão ($2.72 \pm 3.19 \mu\text{m}$), with no significant difference between systems (Fig. 1 and 2). These results raised the suspicion that significant conformational irregularity may exist within the implant chamber against which the abutment stables a contact interface. This suspicion warranted further investigation using microtomography to evaluate possible conformational errors (circularity/roundness) of the implants.

All systems showed conformational errors of circularity on microtomography images (Fig. 3, 4 and Table 1).

Fig.3: Microtomography image (longitudinal section) illustrating the evaluation of circularity at three different heights of the abutment bearing area of the implant (Conexão System)

Circularity error and difference between wall thickness of implant systems tests		
System	Circularity error	Wall thickness (μm)
Nobel Biocare	0.009 (0.002)	0.31 (0.01)
Ankylos	0.008 (0.001)	0.52 (0.00)
Neodent	0.024 (0.023)	0.49 (0.00)
Conexão	0.007 (0.001)	0.32 (0.02)
Kruskal-Wallis	$P = .434$	$P = .104$

Standard deviation in parentheses.

Table 1: Circularity error and difference between wall thickness of implant systems tested

Fig.4: Microtomography illustrative image and scheme to show the circularity error in the evaluated implants. Black circle represents a perfect circularity and red line represents circularity error found

Background and Aim

The presence of microgaps at the implant-abutment interface (IAI) favors accumulation of bacterial biofilm, which may result in inflammation of the peri-implant tissues, adversely affecting treatment outcome and interfering with long-term esthetics and function. Therefore, the risk of bacterial leakage should always be at the forefront of investigations.

The aim of this study was to evaluate bacterial leakage at the IAI of 4 tapered connection implant systems associating it with the microgap between implant and abutment as well as possible conformational errors of the implant platform.

Conclusion

All implant systems tested showed evidence of maladaptation at the IAI, conformational errors of the inner wall of the implant, and bacterial leakage.

The tapered connection systems evaluated herein were not able to halt bacterial leakage nor were they free from conformational errors.

Larger studies are needed to assess the impact of conformational errors within the implant wall on bacterial leakage at the IAI, specially from a clinical point of view.

Methods and Materials

Four brands of implants with tapered abutment connection were tested. Bacterial leakage was assessed using 0.3 μ L of Escherichia coli suspension inoculated into the abutment screw chamber of the implants, which were then torqued and incubated at 37°C for 14 days. All the same specimens used for the microbiological experiment were then cut lengthwise and the microgap measured at three points on each side of the sample using SEM (up to 5000X). Microtomography was used in two new specimens of each system to assess implant platform circularity at three different heights to validate the microscopic findings qualitatively.

To our knowledge, this is the first study to use microtomography to evaluate possible conformational errors of dental implants.

References

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