Titanium and Zirconia External Connection Abutments Produced Following a Digital Protocol: An In Vitro Study

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Purpose: To assess the quality of precision at the implant-abutment interface of single-tooth restorations with titanium and zirconia abutments with hexagonal external connections produced using a digital protocol. ***Materials and Methods:*** A total of 20 abutments were produced with commercially pure titanium, and 20 abutments with zirconia, both following a necessary digital protocol. Rotational freedom of all the abutments was assessed. All data were analyzed according to procedures established by software package STATA 14.2. ***Results:*** No significant differences relative to rotational freedom emerged between the two groups. ***Conclusion:*** This study showed that both types of abutments constantly demonstrated approximately 2 degrees of rotational freedom between implant and abutment where the hexagonal external connection was concerned. *Int J Prosthodont 2019;32:358–360. doi: 10.11607/ijp.6166*

Absence of rotation at the implant-abutment interface is of great importance and has been highlighted in several studies.[1–3] The range of freedom on the surfaces of implant abutments produced with traditional analogic procedures has been evaluated,[1,2,4,5] and some authors have concluded that the greater the increase in abutment misfit, the higher probability of screw joint loosening.[2,3] Nowadays, dental prostheses can be fabricated with direct digitalization using intraoral scanners (IOS). The aim of this study was to evaluate the rotational freedom between the implant hexagonal extension and the abutment hexagonal counterpart of single-tooth restorations with titanium and zirconia abutments with hexagonal connections produced using a completely digital protocol and the same milling system. The null hypothesis of this study was that all titanium and zirconia abutments would exhibit similar precision at the implant-abutment interface.

MATERIALS AND METHODS

Abutment Preparation Procedures

A polymeric resin model (Blue Star Type E, Breitschmid) of a maxillary arch with a standard threaded hexagonal external connection 4.2 × 10 mm implant (W2-EC4210, Resista Implant System, Ing. Carlo Alberto Issoglio & C. S.r.l.) positioned in the second left premolar edentulous site with a 2-mm–deep transmucosal canal was used to reproduce a clinical situation. A scan body (USCNB2, Simbiosi S.r.l.) was positioned on the implant in the resin model using a torque wrench calibrated at 10 Ncm (Torqometer, Snap-on Tools; Fig 1). Forty digital impressions were made using an IOS (CS3600,

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Carestream Dental, Carestream Health). The resulting STL files (Fig 2) were forwarded electronically to the production facility. A milling machine was used (G5 Milling Center Machine, Dental Machine S.r.l.), and 20 abutments were made with commercially pure titanium (group T). A further 20 abutments were made with zirconia (group Z). Rotational freedom between the implant hexagonal extension and the abutment counterpart was measured using a custom-made apparatus similar to that illustrated by Binon[1] and employed in previous research (Fig 3).[4,5]

Statistical Analyses

The continuous variable rotational freedom of the T and Z groups was tested as the primary outcome for normality by means of a Shapiro-Wilk test. Due to a somewhat significant result ($P < .001$), comparison between the two groups was carried out by means of the nonparametric Mann-Whitney *U* test. Before this analysis was undertaken, relevant data were tested to further confirm the absence of any correlation between the two groups, since the dental cast scanned was the same for each impression (correlation value $\rho = 0$). The α level of significance was fixed at $P \leq .05$. All data were analyzed with software package STATA 14.2 (StataCorp LP). The sample size was estimated a priori by analyzing the data published in previous papers in which rotational freedom had to be less than 5 degrees to avoid failure,[1,2] and its average value amounted to 2 degrees for titanium and zirconia abutments, which had been manufactured according to a traditional impression.[4,5] Therefore, in a sample size estimation (*t* test for two-sample means), a value of 1 degree was assumed as being a clinically relevant difference between the two groups (standard deviation 1 degree; power = 0.8; $\alpha = .05$). Under these conditions, the total sample size needed was 34 abutments, 17 for each group.

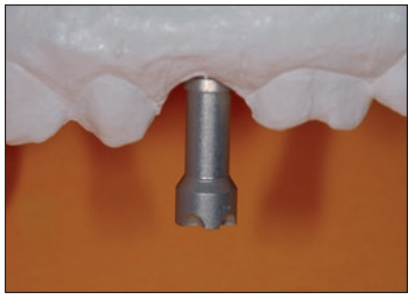

Fig 1 Scan body secured to a standard threaded implant positioned in the second left premolar edentulous site with a 2-mm–deep transmucosal canal in a polymeric resin model.

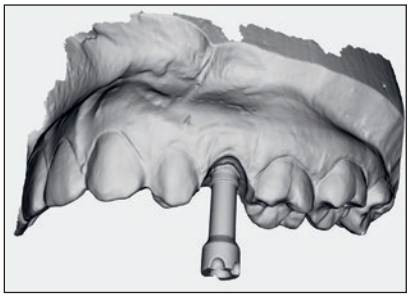

Fig 2 Final digital impressions.

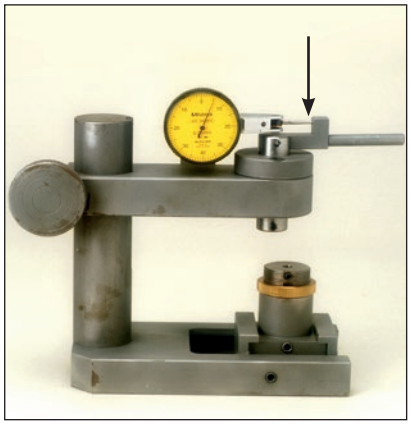

Fig 3 Custom-made apparatus used to assess rotational freedom at the implant-abutment interface. The needle pointer *(arrow)*, with its clockwise and counterclockwise rotation, allowed rotational freedom to be recorded.

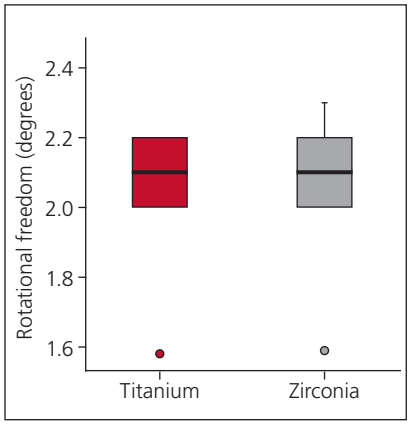

Fig 4 Box plot of rotational freedom in the titanium and zirconia groups.

Table 1 Descriptive Statistics of Rotational Freedom (Degrees) and Differences Between Groups

Rotational freedom	Titanium (n = 20)	Zirconia (n = 20)	Difference between groups
Median (IQR)	2.10 (0.20)	2.10 (0.20)	0.00 (0.30)[a]
Minimum	1.58	1.59	–0.62
Maximum	2.20	2.30	0.41

IQR = interquartile range.
[a]Mann-Whitney test; $P = .6414$.

RESULTS

The degree of rotational freedom proved to have the same value in both groups, as both groups showed a median value of 2.10 degrees (interquartile range [IQR] 0.20; Fig 4), with a median difference value of 0.0 degrees (IQR 0.30, Table 1). Statistical analysis subsequently confirmed that there was indeed no difference between the two groups (Mann-Whitney test, $P = .6414$).

DISCUSSION

The null hypothesis of this study was accepted. In fact, both groups showed a median value of 2.10 degrees, which should allow a stable screw joint and may reduce the risk of screw loosening.[1,2] Within the limitations of this study, it has been shown that the same milling unit can achieve similarly precise final results when two different materials were inserted into the same milling system and using the same files for the fabrication of the abutments. Differences, if there were any, would be the direct result of the milling of the material and the ability to mill a specific material to a certain level of accuracy. It should be underlined that in this research protocol only one milling machine was used, and further research should be carried out with many more milling systems.

CONCLUSIONS

Titanium and zirconia abutments exhibited similar precision at the implant interface.

ACKNOWLEDGMENTS

The authors report no conflicts of interest.

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Literature Abstracts

Predicting Peri-Implant Disease: Chi-Square Automatic Interaction Detection (CHAID) Decision Tree Analysis of Risk Indicators

Further validation of the risk indicators and predictors for peri-implant diseases is required to allow clinicians and patients to make informed decisions and optimize dental implant treatment outcomes. The aim of this study was to build prediction models using chi-square automatic interaction detection (CHAID) analysis to determine which systemic-, patient-, implant-, site-, surgical-, and prostheses-related risk indicators had impact on the onset of peri-implant diseases. A retrospective analysis of 200 patients who received implant-supported prostheses between 1998 and 2011 was conducted to evaluate the prevalences of and risk indicators for peri-implant mucositis and peri-implantitis. The data were further analyzed using CHAID to produce two predictive models. The prevalence of peri-implant mucositis was 20.2% and 10.2% for patients and implants, respectively, while the prevalence of peri-implantitis was 10.1% at the patient level and 5.4% at the implant level. CHAID decision tree analysis identified three predictors (history of treated periodontitis, absence of regular supportive peri-implant maintenance, and use of bone graft) for peri-implant mucositis and three predictors (smoking, absence of regular supportive peri-implant maintenance, and placement of ≥ 2 implants) for peri-implantitis. Within the limitations of this study, CHAID decision tree analysis identified the most plausible risk indicators and provided two predictive models for use in a particular university setting that will allow early detection of peri-implant diseases and ensure appropriate care and maintenance of patients at high risk.

Atieh MA, Pang JK, Lian K, et al. *J Periodontol* 2019 [epub ahead of print Feb 7]. **doi:** 10.1002/JPER.17-0501. **References:** 50. Reprints: Momen A. Atieh, maatieh@gmail.com —*Submitted by Donald Curtis, USA*

A New Approach for the Diagnosis of Systemic and Oral Diseases Based on Salivary Biomolecules

Early diagnosis is the target of contemporary medicine and has an important role in prognosis and further treatment. Saliva is a biofluid that has generated a high interest among researchers due to its multiple advantages over other body fluids. Due to the multitude of components in saliva that can act as biomarkers, existing technologies are being used to develop protocols that could allow saliva to become the new noninvasive diagnostic method. Saliva as a diagnostic tool can bring a substantial contribution to the diagnostic armamentarium, providing important information about oral and general health. The diagnostic applications of saliva have been extended and experienced a rapid evolution due to the advancement in salivaomics. The present review summarizes the latest research in saliva-related studies and explores the information and correlations that saliva can offer regarding systemic and oral diseases, highlighting its great potential for use in diagnoses. It is expected that, in the future, specific guidelines and results regarding salivary diagnostics are to be available, together with high-sensitivity and specificity tests for multiple systemic and oral diseases.

Roi A, Rusu LC, Roi CI, Luca RE, Boia S, Munteanu RI. *Dis Markers* 2019;2019:8761860. **References:** 99. **Reprints:** Laura C. Rusu, laura_cristinap@yahoo.com —*Steven Sadowsky, USA*