Short Communication

Preliminary Laboratory Evaluation of Bicomponent Customized Zirconia Abutments

Luigi Canullo, DDS[a]/Patrizio Morgia, DDS[a]/Fabio Marinotti, LT[a]

The purpose of this descriptive study was to analyze the behavior of a bicomponent custom-made zirconia abutment used with an internal connection implant system. The microscopic marginal fit and specific mechanical characteristics of 20 titanium platform and zirconia abutment complexes were evaluated. Scanning electron microscope analysis showed mean values of 10.03 μm for the horizontal gap and 4.419 μm for the vertical gap for the components. The traction test revealed a mean maximum load value of 190 N, whereas the bending test showed a mean maximum load value of 436 N. *Int J Prosthodont 2007;20:486–488.*

Esthetic challenges in implant prosthodontics may be addressed by using die cast ceramic; however, ceramic materials are not always suitable to bear occlusal loads in the posterior dentition. Metal abutments offer better physical properties but compromised esthetics, especially in the gingival margin area.

The present study analyzed the behavior of a bicomponent abutment made of a titanium post luted to a custom-made zirconia abutment using anaerobic cement. The bicomponent complex was used for an internal connection implant system to address both esthetic and functional expectations.

Materials and Methods

Twenty titanium posts (ProUnic, Impladent) and custom-made zirconia abutments complexes (Zirkozahn) were constructed and arbitrarily divided into 2 groups. In group 1, a titanium post with a diameter smaller than the implant platform was used. The zirconia abutment lower margin was then positioned directly onto the implant margin (Fig 1). In group 2, the metallic structure occupied the entire thickness of the implant neck, with the zirconia closure margin on the abutment at a more coronal level (Fig 2). Both groups were tested using scanning electron microscopy (SEM) (Vega Tescan, Tesca), followed by mechanical resistance tests. Five complexes of each group were traction tested and the remaining samples were bending tested.

The samples were anchored onto a 5-KN electromechanical electronic test machine (TC5, LBG) to test universal materials, composed of a sturdy frame with 2 columns and a mobile crossbar piloted by preloaded spherical recirculation screws with no clearance (Fig 3). This machine was driven at a traveling speed of 5 mm/min. The detaching force of the zirconia abutment from the titanium support was then assessed.

For the bending test, the abutment was fitted with a 5 mm wider span than the thrust element. The maximum loading force was reached using a constant speed until the abutment completely detached from the titanium support. The bending force was applied with a 30-degree inclination.

[a]*Private Practice, Rome, Italy.*

Correspondence to: *Dr Luigi Canullo, Via Nizza, 46 00198 Rome, Italy. Fax: +39 06 8411980. E-mail address: luigicanullo@yahoo.com*

Fig 1 *(left)* Lower margin of the zirconia abutment (group 1).

Fig 2 *(right)* Frontal view of the zirconia abutment (group 2).

Fig 3 *(left)* Test machine for the traction and bending tests.

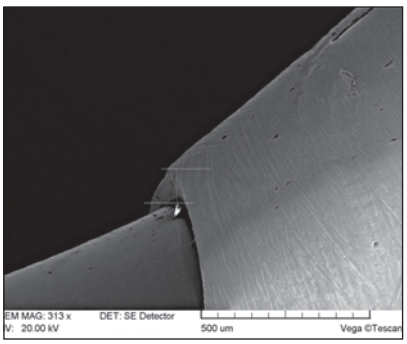

Fig 4 *(right)* SEM analysis of the horizontal gap.

Results

SEM analysis revealed extremely low marginal gap values between the zirconia abutment and implant margin (group 1) or the titanium connection platform (group 2). The horizontal gaps in both groups showed values from 9.961 to 12.391 µm (average: 10.03 µm) (Fig 4). The vertical gaps in both groups showed values from 3.878 to 5.235 µm (average: 4.419 µm).

In the traction test, the main maximum load value was 190 N. In the bending test, the main maximum load value was 436 N. Observation of both components after detachment revealed that the cement remained completely attached to the titanium implant without signs of fracture on the zirconia abutment.

Discussion

Ceramic abutments offer optimal esthetic results and excellent hard and soft tissue adaptation[1] but compromised function when subjected to heavy occlusal loads. The introduction of the computer-aided design/computer-assisted manufacture systems associated with the use of materials such as zirconia has improved mechanical properties of prostheses without altering esthetic characteristics.[2] In this preliminary report, a bicomponent internal connection abutment underwent tests of resistance to traction, bending, and scrutiny of marginal fit. The abutment's metallic core was necessary to recreate the internal connection with acceptable precision. In fact,

completely "metal-free" abutments are only possible for external hexagon systems.[3] In the SEM analysis, the vertical and horizontal marginal gap measurements between the zirconia abutment and metallic support revealed low values (horizontal, 9.961 µm; vertical, 3.878 µm). This suggests the potential for minimal bacterial infiltration and presumably good biocompatibility.

Despite being a "customized" prosthesis, the marginal gap of the model studied compared favorably to the average values (5 µm)[4] reported for prefabricated connection systems. The bending test was carried out to simulate stress deriving from eccentric chewing movements. The traction test was performed to test the cement resistance. The forces applied during the test are presumed to be higher than normal masticatory forces. The values obtained during the bending test were close to those described in the literature for external hexagon zirconia abutments.[5]

The preliminary results demonstrated the *locus minoris resistenziae* of the complex: the cement. The breakage only involved separation of the components, without any observed fractures. An increase in the zirconia abutment-post contact surfaces to improve the anaerobic cement's retentive function may be achieved either by sandblasting the abutment's internal surfaces or by creating a chamfering or counter-chamfering system. Clearly, more extensive in vitro research is necessary before these preliminary observations can be effectively transferred into routine clinical practice.

Conclusions

These preliminary results along with the bicomponent esthetic abutment suggest comparable marginal fit and physical properties to currently available esthetic abutments.

Acknowledgments

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References

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Literature Abstract

Chlorhexidine preserves dentin bond in vitro

This hypothesis being tested in this in vitro study was that matrix metalloproteinase (MMP) inhibition by chlorhexidine application prior to formation of the hybrid layer would decelerate the decrease of bond strength frequently seen in the microtensile model after aging. Deep Class I preparations in extracted third molars were sectioned into 2 halves buccolingually. One half was customarily restored (etch-and-rinse adhesive/resin composite) and the other was treated with 2% chlorhexidine after being acid-etched before restoration. Teeth were stored in distilled water for 1 week, after which specimens were prepared for testing. Microtensile bond strengths and failure mode distribution under scanning electron microscopy were analyzed immediately after specimen preparation and 6 months later. The storage medium used during the 6 months was artificial saliva with/without protease inhibitors. Chlorhexidine application had no effect at 1 week, but showed significantly better preservation of bond strength after 6 months. Protease inhibitors in the storage medium had no effect. Failure analysis showed significantly less failure in the hybrid layer with chlorhexidine at 6 months, compared with controls. In conclusion, this in vitro study suggests that chlorhexidine might be useful for the preservation of dentin bond strength. However, since this study included only one adhesive system, the authors suggest that the recommendation of the use of chlorhexidine application after acid-etching must at this point be limited to the adhesive in question.

Carrilho MR, Carvalho RM, de Goes MF, et al. *J Dent Res* 2007;86:90–94. **References:** 26. **Reprints:** Dr L Tjaderhane, Institute of Dentistry, University of Helsinki, PO Box 41, 00014. E-mail: leo.tjaderhane@helsinki.fi—*Tapan N. Koticha, National University of Singapore Faculty of Dentistry, Singapore*