Adhesive Strength of the Luting Technique for Passively Fitting Screw-Retained Implant-Supported Prostheses: An In Vitro Evaluation

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Purpose: This in vitro study evaluated the adhesive strength of a technique to lute implant cylinders to metal frameworks in implant-supported prostheses and ensure a good passive fit. ***Materials and Methods:*** Different height samples were tested: In group 1, implant cylinders were 5 mm long; in group 2, they were 10 mm long. A universal testing machine (Instron) was used to perform pull-out tests. ***Results:*** The luting technique provided enough adhesive strength for clinical use with greater adhesive strength in group 2 (mean pull-out strength: 2.85 kN in group 1 versus 3.79 kN in group 2). ***Conclusions:*** The luting technique provides enough adhesive strength for clinical use. Moreover, specimens with a larger surface for adhesion demonstrated higher adhesive strength compared with shorter specimens *Int J Prosthodont 2015;28:37–39. doi: 10.11607/ijp.3976*

The laboratory luting technique evaluated in this study is part of the Columbus Bridge Protocol[1,2] for full-arch immediate loading rehabilitation of edentulous maxillae. It allows for bonding metal frameworks to implant cylinders' restorative components. The technique compensates for distortions due to how the metal framework is cast and has been shown to produce well-fitting frameworks.[3] The result is a screw-retained fixed prosthesis with a rigid metal framework. The luting technique has the advantage of being relatively quick, which renders it particularly suitable for immediate loading procedures in contrast with other techniques (eg, laser welding) that are more time-consuming.

Despite its possible advantages, the luting technique is rarely used—the main complaint being the failure of adhesion.[4] The aim of this investigation was to evaluate the adhesive strength of the luting technique using implant cylinders of different heights.

Materials and Methods

The samples were realized by luting a titanium type IV cylinder with an external castable cylinder (Biomet 3i) simulating part of the prosthetic framework (commercial gold alloy, Esteticor Blancor, Cendres+Mètaux). Two vertical ridges within the external cylinder (matching two grooves on the inner cylinder) were designed to prevent rotation between the two cylinders and to maintain a consistent space of 0.2 mm between them (Fig 1). The cylinders were designed with extended metal portions that were machined to become threaded and allow for engagement with the testing machine (Fig 2). Sint Tech Technology provided the prolonged inner cylinder, while the prolonged external cylinder was produced by dental laboratory Seghesio & Scaglione.

The cylinders were cemented using an anaerobic acrylic resin composite luting agent (Ceka Site, Alphadent) by one operator following the manufacturer's instructions. The titanium cylinders were sandblasted before luting with 125-μm aluminium oxide particles for 3 seconds at a working distance of 5 mm and a pressure of 85 psi. After luting, the excess material was removed. The portion of the cylinders intended for luting was either 5 (group 1) or 10 mm long (group 2; Fig 2a). Ten samples per group were produced.

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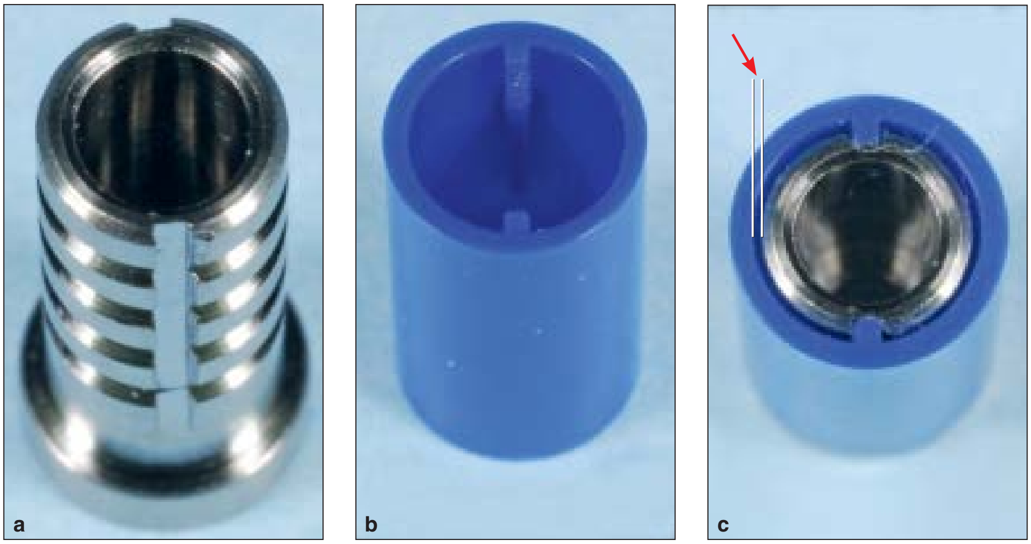

Fig 1 **(a)** Titanium cylinder and **(b)** external castable cylinder. **(c)** The vertical relief areas in the castable cylinder match the grooves on the external surface of the titanium cylinder and maintain a constant space of 0.2 mm between the titanium and castable cylinder.

Fig 2 **(a)** Samples used during the investigation; **(b)** Instron machine during testing.

Adhesive strength was evaluated by pull-out tests using an Instron machine (Instron 8501 Plus) with a 10-kN load cell (Fig 2b).

Each specimen was subjected to tensile load at a cross-head speed of 2 mm per minute at 27°C and 70% humidity. The software Plus Windows 98, Series IX version 8 was employed for data acquisition and processing. Maximum loads at failure of the specimens were recorded.

Data were blindly analyzed by a statistician using SPSS software version 18 (SPSS). Mean values of force and SD were recorded for both groups. A Student *t* test for independent data was used to evaluate differences between the groups. A *P* value of .05 was considered statistically significant.

Results

All of the specimens failed due to detachment at the level of the adhesive agent between the internal and the external cylinder. Results are reported in Table 1.

Mean maximum pull-out strength was 2.85 kN (SD: 0.94) for group 1 and 3.79 kN (SD: 1.48) for group 2. The difference between the two groups was statistically significant (P = .012).

Discussion

The present in vitro study observations and recordings showed that the mean tensile force needed to unglue the luted cylinders was 2.85 kN and 3.79 kN for groups 1 and 2, respectively. The typical gold screw-in implant is designed to fail at approximately 600 N.[5] Therefore, the mechanical properties of the luting agent adequately surpassed this magnitude.

In an in vitro pull-out test, Randi et al[6] found that three of the five cement-retained restorations evaluated surpassed the tensile strength of the gold retaining screws (76 kg).

All of the specimens used in the present study were realized in a standardized manner. It would not be possible to predict the outcomes if certain variables were introduced to the operative procedures, namely treatment of the specimens before luting, type of cement, cement film thickness, etc.

Table 1 Pull-out Force (kN) Recorded in Test 3 for Group 1 (5-mm-long samples) and Group 2 (10-mm-long samples)

Sample	Group 1	Group 2
1	2.76341	3.74552
2	2.80963	2.58685
3	3.04594	3.40031
4	2.82337	2.79235
5	2.3674	3.34805
6	2.92497	4.33537
7	3.75967	3.0651
8	2.72947	3.96602
9	2.97536	5.76367
10	2.34928	4.89087
Mean	2.85485	3.789411
SD	0.94	1.48

Conclusions

The results suggest that the luting technique provides enough adhesive strength for clinical use. Moreover, specimens with a larger adhesive surface demonstrated greater adhesive strength compared with shorter specimens.

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