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Effects of abutment length and platform size on the retention of implant-supported CAD/CAM crowns using six different cements

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Retention

The selection of an appropriate dental cement for a clinical application can be challenging. A wide range of dental cements with different properties are commercially available for use in the cementation of implant prostheses, but there is no agreement on which cement is the most appropriate.[1,2] Recently, non-eugenol and acrylic/urethane-based cements have been developed specifically for implant-supported restorations and they have claimed to provide long-term retention as well as easy restoration removal due to their elastic properties.[3]

A recently formulated hybrid bioceramic cement including calcium aluminate and glass-ionomer has been introduced for permanent cementation of metal-ceramic and all-ceramic crowns.[4] There are some studies regarding the biological and physical properties of hybrid bioceramic cements in the literature. To our knowledge, there is no report presenting any data related to the retention of these cements and their correlations with various implant abutment features (length and platform size). The aim of this study was to assess the retention strength of hybrid bioceramic cement by comparing it with those of other traditional luting agents on four types of implant abutments.

Titanium prefabricated abutments (standard short, standard long, wide-body short, wide-body long) were screwed onto implant analogs (Oxy implants, ASAIN 525, Biomec SRL, Colico, Italy), the surface areas of all abutments were calculated by a software (3DS Catia, Dassault Systems America Corp, Waltham, MA, USA) (Fig. 1A). A total of 144 metal crowns (36 for each abutment type) with 1 mm occlusal and 0.5 mm proximal metal thicknesses, and 40 μm cement gaps were designed with a software (EOS Software for Additive Manufacturing, EOS of North America, Inc, Pflugerville, TX, USA), and then fabricated by using direct metal laser sintering (EOSINT M 270, EOS of North America, Inc, Pflugerville, TX, USA). The intaglio surface of each crown made of cobalt-chromium alloy was sandblasted by 50 μm aluminum oxide particles and then steam-cleaned and air-dried.

Six different luting cements (4 permanent and 2 temporary) were utilized:

1) hybrid bioceramic (Ceramir C&B, Doxa Dental AB, Uppsala, Sweden),
2) zinc phosphate (Adhesor, Spofa Dental, Prague, Czech Republic),
3) composite resin (Panavia F 2.0, Kuraray America, New York, NY, USA),
4) glass-ionomer (Ketac-Cem, Espe-Premier Dental Products, Norristown, PA, USA),
5) non-eugenol urethane/acrylic-based (ImProv, Nobel Biocare, Yorba Linda, CA, USA),

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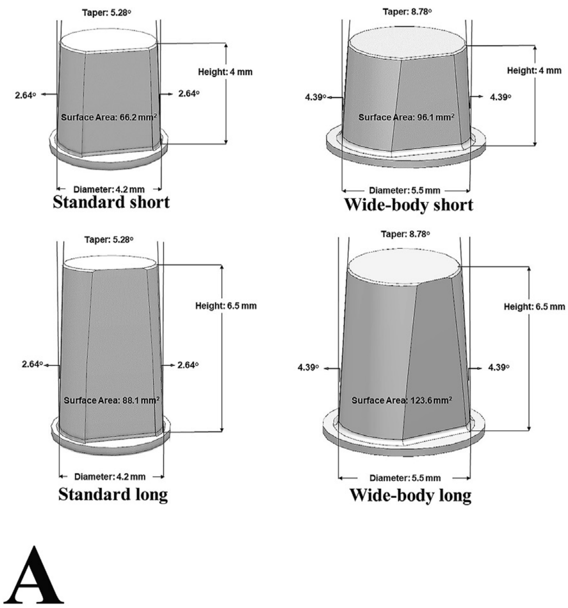

Abutment	Cement	Mean retention strength (N) ± SD
Standard short	DentoTemp	45.5 ± 9 [a]
	Panavia F 2.0	200.6 ± 27 [b]
	ImProv	201.7 ± 61 [b]
	Ketac Cem	210.7 ± 44 [b]
	Ceramir C&B	260.9 ± 70 [b]
	Adhesor	283.4 ± 71 [b]
Wide–body short	DentoTemp	52.4 ± 31[a]
	ImProv	187.6 ± 66 [b]
	Panavia F 2.0	210.5 ± 44 [b]
	Ketac Cem	232.1 ± 51 [b, c]
	Ceramir C&B	308.5 ± 77 [c, d]
	Adhesor	343.7 ± 50 [d]
Standard long	DentoTemp	84.5 ± 23 [a]
	ImProv	225.4 ± 71 [b]
	Ketac Cem	283.1 ± 40 [b, c]
	Panavia F 2.0	306.1 ± 93 [b, c, d]
	Ceramir C&B	390.1 ± 116 [c, d]
	Adhesor	419.3 ± 37 [d]
Wide–body long	DentoTemp	83.2 ± 36 [a]
	Ketac Cem	247.1 ± 30 [b]
	ImProv	270.1 ± 75 [b, c]
	Adhesor	378.1 ± 35 [c, d]
	Panavia F 2.0	394.9 ± 99 [c, d]
	Ceramir C&B	425.3 ± 114 [d]

B

Figure 1 Titanium prefabricated abutments and statistical evaluations. (A) Detail information about four types of abutments. (B) Statistical comparisons of mean retention strength values of the cements according to the abutment types. Vertically, mean values with identical letters indicates no statistically significant differences ($p > 0.05$), while mean values with non-identical letters indicates statistically significant differences ($p < 0.05$). SD: standard deviation.

6) non-eugenol urethane/acrylic-based (DentoTemp, Itena-Clinical, Paris, France).

The crowns were cemented on their respective abutments with finger pressure, then loaded with 5-kg weight constantly for 10 min. Excess cement was removed with a plastic scaler. After cementation, the specimens were allowed to set for 24 h.

A pull-out test using a universal testing machine was carried out to evaluate the retention strength of cements. The loads required to remove crowns were recorded in Newtons (N). For statistical analysis a one-way ANOVA test was used to determine differences among the six different cement groups. The level of significance was set at $p < 0.05$.

The mean retention strength values of each cements are provided in Fig. 1B. Zinc phosphate cement provided the highest mean values for the standard short, wide-body short, and standard long abutments. Hybrid bioceramic cement showed the highest mean value for the wide-body long abutment. The lowest mean values with all abutments were observed for non-eugenol and urethane/acrylic-based cement (DentoTemp). In general, an increase in abutment length resulted in a significant increase in the retention of certain cements ($P < 0.05$), whereas increase in abutment platform size did not lead to significant increase in the retention of cements ($P > 0.05$).

The findings of this study suggest that hybrid bioceramic cement is a viable option for implant-supported CAD/CAM crowns when high retention is needed.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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