Retentiveness of Various Luting Agents Used with Implant-Supported Prostheses: A Preliminary In Vitro Study

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The aim of this preliminary in vitro study was to compare the retentiveness of a luting agent designed for use with dental implants to luting agents designed for use with tooth-retained restorations. The following luting agents were tested: *(1)* implant cement, *(2)* resin-bonded zinc oxide–eugenol cement, *(3)* zinc phosphate cement, *(4)* zinc polycarboxylate cement, and *(5)* glass-ionomer cement. After cementation, each sample was subjected to a pull-out test using a universal testing machine, and the loads required to remove the crowns were recorded. The mean values and standard deviations of cement failure loads were analyzed using analysis of variance and the Bonferroni test. The mean cement failure loads (N) were 333.86 ± 18.91 for implant cement, 394.62 ± 9.76 for resin-bonded zinc oxide–eugenol cement, 629.30 ± 20.65 for zinc phosphate cement, 810.08 ± 11.52 for zinc polycarboxylate cement, and 750.17 ± 13.78 for glass-ionomer cement. The retention provided by polycarboxylate cement was significantly greater than that of all other luting agents; the implant cement showed the lowest retention values. These preliminary in vitro observations need to be confirmed under conditions that more closely approximate the clinical environment. *Int J Prosthodont 2013;26:82–84. doi: 10.11607/ijp.2572*

Proper selection of a provisional or definitive luting agent for cement-retained implant-supported prostheses is a complex and frequently debated issue.[1] This preliminary in vitro study compared the retentiveness of a luting agent designed for use with dental implants to luting agents designed for use with tooth-retained restorations

Materials and Methods

Ten implant analogs (EZ Hi-Tec Internal Hex, Hi-Tec Implants) were mounted in individual autopolymerizing acrylic resin blocks. A titanium abutment (EZ Hi-Tec Internal Hex, Hi-Tec Implants) was placed on each implant analog and torqued to 35 Ncm. The occlusal access openings of the abutments were filled with modeling wax, and 50 standardized copings were waxed (Crown Wax, medium hard, Bego) directly onto the unmodified abutment with a 15-mm-long sprue. Finished wax patterns were invested and cast with nickel-chromium alloy (Wiron, Bego). Fitting surfaces of the metal copings were sandblasted with 50-µm aluminum oxide particles (Korox 50, Bego) for 5 seconds. The castings (Fig 1) were randomly divided into five experimental groups (10 specimens per group). The test specimens in each group were cemented with one of five luting agents (Table 1). In accordance with American Dental Association specification no. 96, copings were seated quickly on the abutment with hand pressure for 10 seconds, followed by placement of a 5-kg load using a cementation jig for 10 minutes. After storing the implant analog/abutment/coping assemblies in physiologic saline solution for 24 hours at 37°C, the specimens were subjected to tensile loading using a universal testing machine (LR 50K, Lloyd) at a constant crosshead speed of 0.5 mm/min (Fig 2). Abutment surfaces were steam cleaned to remove any residual luting agent. Subsequently, all specimens were subjected to testing.

Statistical analysis was carried out using one-way analysis of variance and multiple comparisons (post hoc tests) using the Bonferroni test.

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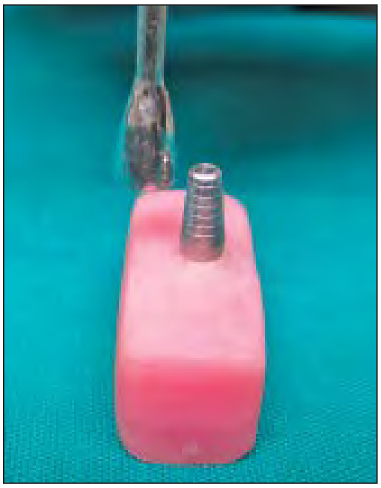

Fig 1 *(left)* Metal coping fabricated to align with the implant abutment.

Fig 2 *(right)* Specimen subjected to the pull-out test on the universal testing machine.

Table 1 Luting Agents Used in This Study

Group	Luting agent	Type	Manufacturer
1	Kalzinol	Resin-bonded zinc oxide–eugenol cement (provisional luting agent)	DPI
2	Premier Implant Cement	Non-eugenol temporary resin cement (specifically designed implant cement)	Premier
3	De Trey Zinc	Zinc phosphate cement (definitive luting agent)	Dentsply
4	Poly-F	Zinc polycarboxylate cement (definitive luting agent)	Dentsply
5	GC Gold Label	Glass-ionomer cement (definitive luting agent)	GC

Table 2 Analysis of Variance for Cement Failure Loads (N)

Group	n	Mean	SD	Minimum	Maximum	F	*P*
1	10	394.6	9.8	381.0	410.2		
2	10	333.9	18.9	306.4	359.7		
3	10	629.3	20.6	595.7	653.2	1864.6	< .001
4	10	810.1	11.5	794.0	827.4		
5	10	750.2	13.8	729.8	769.2		

SD = standard deviation.

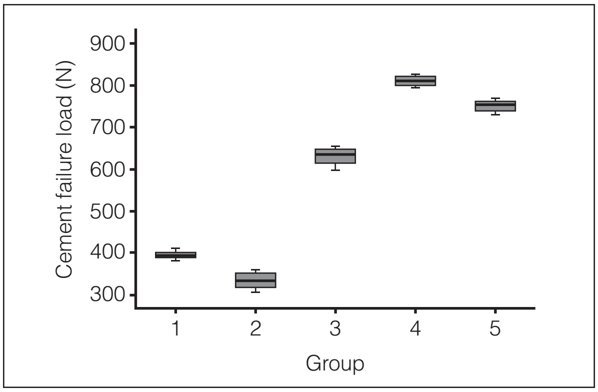

Fig 3 Box plot of the cement failure loads.

Results

The results are shown in Table 2 and Fig 3. The implant cement showed the least retention, while zinc polycarboxylate cement provided the highest retention. The difference in mean cement failure loads between groups was statistically significant ($P < .001$). Multiple comparisons using the Bonferroni test showed significant differences between different pairs of groups.

Discussion

The scope of this preliminary study was clearly of limited clinical value since the results were bound to be obvious. However, the authors considered the study justified because it provides tangible evidence regarding the appropriate selection of luting agent when permanently cementing implant-supported prostheses. Consequently, and as expected, the results show that the provisional luting agent was far less retentive than the definitive luting agents; further, the retention provided by polycarboxylate cement was significantly greater than that of the other cements. This finding was similar to that of Wolfart et al[1] but not to clinical experience in traditional fixed prosthodontics.[2] This result is most likely explained by the adhesive properties of zinc polycarboxylate cement, which adheres to tooth structure by chelation of calcium ions and to metal substrates by chelation of metallic ions. Jendersen and Trowbridge[3] showed that the tensile bond strength of polycarboxylate cement for metal-metal adhesion (1,300 psi) was higher than for metal-tooth adhesion (800 psi).

The lesser retentive value found for glass-ionomer cement may have been due to early water contact, resulting in dissolution of matrix-forming cations and anions in the surrounding areas.[4] The lowest retentive value was found for the implant cement, which is designed to facilitate easy retrieval of prostheses. It must be emphasized that this study's use of direct tensile force applied along the long axis of the cemented copings is not comparable to the complex forces that occur in vivo. However, previous studies have suggested that direct tensile loading can be considered to reflect the clinical situation when standardized methods are followed during specimen fabrication.[5] Moreover, the castings in this study were made from base metal alloy, and the results may have varied if a precious metal alloy, titanium, or some other material had been used.

Conclusions

The results of this study provide a possible preliminary ranking of luting agents based on their ability to retain an implant-supported prosthesis and facilitate easy retrieval. These preliminary in vitro results need to be further studied in a clinical context.

Acknowledgments

The authors reported no conflicts of interest related to this study.

References

1. Wolfart M, Wolfart S, Kern M. Retention forces and seating discrepancies of implant-retained castings after cementation. Int J Oral Maxillofac Implants 2006;21:519–525.
2. Rosenstiel SF, Land MF, Crispin BJ. Dental luting agents: A review of the current literature. J Prosthet Dent 1998;80:280–301.
3. Jendersen MD, Trowbridge HO. Biological and physical properties of a zinc polycarboxylate cement. J Prosthet Dent 1972; 28:264–271.
4. Anusavice KJ. Phillips' Science of Dental Materials, ed 11. St Louis: Saunders, 2006:471–475.
5. Ergin S, Gemalmaz D. Retentive properties of five different luting cements on base and noble metal copings. J Prosthet Dent 2002;88:491–497.

Literature Abstract

Methamphetamine abuse and oral health: A pilot study of "meth mouth"

This pilot study compared the overall dental status, salivary quality and quantity, as well as oral hygiene, of subjects with a history of methamphetamine (meth) abuse with that of control subjects without a history of meth abuse. The effect of the route and extent of meth abuse and concomitant drug abuse was also studied. Twenty-eight meth abusers (either current or with a history of meth abuse within the previous 12 months) and 16 controls subjects were included in the study. Questionnaires were administered by psychologists with specialties in addictive disorders. The questions included history of meth abuse and frequency and method of ingestion, as well as oral hygiene habits, general knowledge of oral health, recent dental treatment, and diet. Oral examinations by trained dentists consisted of decayed missing filled surfaces (DMFS) index, soft tissue examination, oral hygiene, and saliva analysis. Wilcoxon two-sample rank sum tests ($\alpha = .05$) were used compare the caries indices and diet between the test groups. Fisher exact test ($\alpha = .05$) and Spearman rank correlation tests ($\alpha = .05$) were used to assess significant oral health characteristics and meth abuse. This study found that meth abusers have significantly higher DMFS indexs ($P = .023$), decayed surfaces ($P = .0054$), missing teeth ($P = .0272$), and tooth wear ($P = .005$). Moreover, meth abusers also had poor oral hygiene ($P < .0001$), a diet high in carbonated beverages ($P = .0018$), and infrequent dental visits ($P = .0438$). Saliva analysis showed that meth abusers had significantly lower salivary pH ($P = .0017$) and decreased buffering capacity ($P < .0001$). However, no significant difference in salivary flow rates was found. The authors concluded that meth abuse may also impact salivary quality, and suggested further research in this area.

Ravenel MC, Salinas CF, Marlow NM, Slate EH, Evans ZP, Miller PM. *Quintessence Int* 2012;43:229–237. **References:** 16. **Reprints:** Dr Michele C. Ravenel, Department of Stomatology, College of Dental Medicine, Medical University of South Carolina, 173 Ashley Ave, PO Box 250507, Charleston, SC 29425. Email: ravenelm@musc.edu—*Simon Ng, Singapore*