Influence of screw access on the retention of cement-retained implant prostheses

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Statement of problem. Many studies have compared cement-retained and screw-retained implant prostheses. One disadvantage of cement-retained crowns is the lack of predictable retrievability, which can be overcome by creating a screw access channel on the occlusal surface.

Purpose. The purpose of this study was to evaluate the influence of a screw access channel on the retention of cement-retained implant prostheses.

Material and methods. Sixteen cast metal crowns were fabricated and divided into 2 groups of 8 specimens each: a control group (CG) comprising 8 cement-retained prostheses and an experimental group (EG) comprising 8 cement-retained prostheses with a screw access channel. Castings were cemented to abutments with RelyX U100, and the opening screw access channels of EG were filled with photopolymerized composite resin (Filtek Supreme XT). The tensile force required to separate the cemented castings from the abutments was measured after 24 hours of cementation with a universal load-testing machine (EMIC DL 2000). A significance level of 5% (α=.05) was considered statistically significant (Statistical analysis was performed by Kolmogorov-Smirnov non-parametric test and the Student *t* test).

Results. The mean force required to achieve the separation was 191 N for the control group (CG) and 161 N for the experimental group (EG). As shown by the nonparametric Kolmogorov-Smirnov test, the dependent variable followed a normal distribution (*P*=.923). The Student *t* test found no statistically significant difference (*P*=.353) between the groups.

Conclusions. Fabricating cement-retained implant prostheses with screw access does not compromise or reduce the retention of the crowns.(J Prosthet Dent 2013;109:264-268)

Clinical Implications

The lack of retrievability is the main disadvantage of cement-retained implant prostheses. This study suggests that creating a screw access channel does not reduce crown retention. Thus, this simple and low cost technique may provide retrievability to cement-retained implant crowns.

The type of retention system for implant-supported prostheses should be selected before the surgical stage to determine the most appropriate location of the implant. Criteria such as anchoring, parallelism, surface area, the height of the edentulous space, esthetics, occlusal patterns, and the presence of parafunction should also be considered.[1-3]

Different opinions exist regarding the optimal type of implant-supported restoration. Advantages and disadvantages of screw-retained and cemented restorations have been discussed.[3] Screw-retained prostheses have been used successfully in completely edentulous patients because of their retrievability and practicality, and when the position of the implant allows. For example, in the presence of a prosthetic cantilever and in limited prosthetic spaces, they are the first treatment option.[1,3] However, for treating partial edentulism, cemented implant prostheses have been advocated.[4] According to some authors,[2,5] this

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method should be the first treatment option when esthetics is paramount and when implants are misplaced.

Lack of passivity has been correlated with mechanical and biologic complications. Nonpassive screw-retained prostheses result in a larger concentration of stress around the implants than with cemented prostheses.[6] Small misalignments of the cemented prosthesis can be compensated with cementation. Thus, it may contribute to a uniform stress transfer throughout the prosthesis/implant/bone assembly.[2,5]

Screw-retained prostheses offer several advantages, including retrievability and ease of maintenance. The prosthesis may be removed for crown repair (ceramic fracture, screw loosening), providing a better assessment of oral hygiene and periimplant probing, and the exchange of components due to screw loosening or fracture.[1-5,7] In addition, cementation runs the risk of incomplete cement removal, which can result in periimplant inflammation, edema, ulceration, exudate presence, and bleeding upon probing.[8]

For patients with reduced intermaxillary space, screw-retained prostheses are recommended as they do not require increased space for the intermediate elements.[9] Compared with screw-retained prostheses, cemented prostheses show better occlusion, esthetics, and passive prosthetic structure fit.[1]

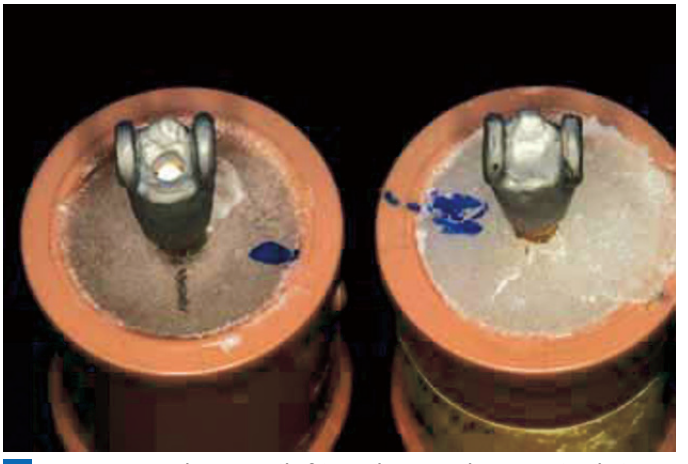
Occlusion is an important factor in selecting the restoration type. For posterior restorations, the implant should ideally be centrally placed such that the force generated is axially directed. In cemented prostheses, occlusal contacts are more stable because the screw access channel that occupies a significant portion of the occlusal table is absent.[10] The occlusal contacts are usually located in this area, and the material sealing the channel, typically resinous compounds, is of questionable effectiveness.[4] In fact, some studies have shown that less force is necessary to fracture screw-retained implant crowns.[2,11]

Fabricating cemented prostheses is simpler and less costly than fabricating screw-retained prostheses. The techniques are similar to those of a traditional tooth-supported prosthesis, with no need for additional training of dental technicians or the use of more expensive components, as may be required for screw-retained prostheses.[3] However, a major concern of cement-retained implant prostheses is the difficulty in removing them to correct abutment screw loosening. Several authors have sought to add a retrievability feature to cemented prostheses to facilitate removal.[5,12-16]

In order to obtain retrievability, several techniques have been described, including the use of interim cement,[1,4,17] staining the occlusal surface at the location of the screw access channel,[18] with a small lingual screw to secure the crown to the abutment,[19] fabricating a lingual retrieval slot at the abutment/prosthesis interface,[20] and using digital photographs[21] or vacuum-formed templates to identify the position of the screw.[14]

The present study aimed to evaluate the influence of the access channel on the retention of cemented prostheses. Little or no data examining the physical and mechanical properties of cemented prostheses with screw access have been published. As this incorporates the simplicity of cemented prostheses and the retrievability of screw-retained prostheses, it may be an important option in the fabrication of implant prostheses, provided this process does not reduce biomechanical quality. The null hypothesis was that creating screw access on cement-retained crowns in order to permit retrievability would not compromise retention.

1 Metal copings before cementation.



2 Experimental group (left) and control group (right) assemblies.

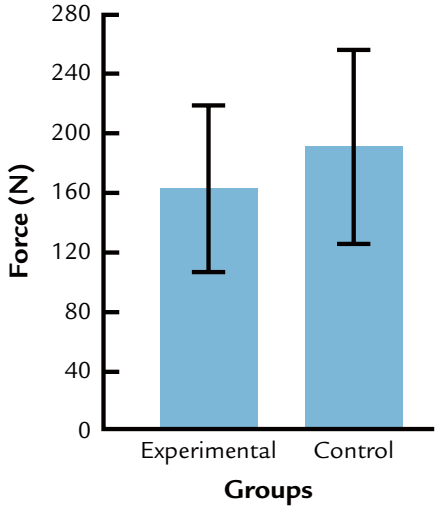
MATERIAL AND METHODS

Fabrication of specimens

For this experiment, after sample size calculation and assuming a statistical power of 80%, 16 external-hexagon implant analogs (Análogo 09004; Bionnovation, São Paulo, Brazil) were aligned vertically in a 7-cm tall and 2-cm diameter polyvinyl chloride (PVC) pipe with the aid of a dental surveyor. Acrylic resin (Biocryl; Scheu-Dental GmbH, Iserlohn, Germany) was poured, and the apparatus was maintained until polymerized. Sixteen premilled titanium abutments with 2-mm collar height (TIPREP code 06009; Bionnovation, São Paulo, Brazil) were screwed to the analog and tightened to 35 Ncm.

Sixteen metal copings (Co-Cr) were fabricated for cement-retained implant prostheses (Fig. 1). Eight of these crowns were conventional, constituting the control group (CG). The other 8 crowns, comprising the experimental group (EG), were made with a screw access channel through the metal. All specimens were cemented with a self-adhesive resin cement (RelyX U100 Universal; 3M Brazil Ltd, Sumaré, Brazil) according to the manufacturer's recommendations (Fig. 2). Excess cement was removed with an explorer. After cementation, the screw channel of the EG specimens (with screw access) were filled with composite resin (Filtek Supreme XT; 3M ESPE).

3 Specimen positioned for bond strength testing.



4 Mean tensile removal force for each group.

TABLE I. Group statistics

Group	Minimum	Maximum	Mean	SD	SD Error Mean
Control group	92	266	191	65	23
Experimental group	89	248	161	58	20

Bond strength test

After cementation, all specimens were stored for 24 hours before tensile testing was performed. A universal testing machine (EMIC DL 2000; EMIC Equipment Systems and Test Ltda, Sáo José dos Pinhais, Brazil) was used to apply a vertical force to the metal copings from the abutments at a crosshead speed of 0.5 mm/min (Fig. 3). The force at which bond failure occurred was recorded in newtons. The data were pooled and subjected to statistical analysis (Kolmogorov-Smirnov non-parametric test and the Student *t* test).

RESULTS

The test results assessing the minimum tensile force for removal of the metal copings cemented over the abutment are presented in Figure 4.

Mean tensile force and standard deviation (SD) results for each group are presented in Table I. The control group (CG) required a 191 N average force to displace the crown, with a minimum value of 92 N and maximum value of 266 N. In the experimental group (EG), the mean strength was 161 N, the minimum value 89 N, and the maximum value 248 N. The nonparametric Kolmogorov-Smirnov test showed that the dependent variable followed a normal distribution (P=.923).

The means of the control and experimental groups were compared with the Student *t* test (Table II). No statistically significant difference (P=.353) between the control and experimental groups was noted.

Table II. Statistical distribution of results (Independent samples test)

	Levene Test for Equality of Variances		Student *t* test for Equality of Means						
								95% Confidence Interval of Difference	
Group	F	*P*	*t*	*df*	*P* (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variance assumed	.597	.453	.961	14	.353	29.79	30.99	-36.68	96.25
Equal variance not assumed			.961	13.796	.353	29.79	30.99	-36.77	96.34

DISCUSSION

The results of this study do not support rejecting the null hypothesis. Tensile force tests showed that the displacement force required in conventional cemented prostheses did not significantly differ from that of modified cement-retained implant crowns with screw access on the occlusal surface.

Many articles have been published regarding the differences between screw-retained and cement-retained prostheses.[1-6,11] Although improved esthetics may be achieved with cement-retained implant crowns, retrievability may influence the type of restoration. Repairing cemented prostheses is more complex and costly than repairing screw-retained prostheses.[4] If the screw access opening location is not known, the removal of cement-retained crowns with abutment screw loosening or ceramic fracture may be difficult without irreversible damage to the crown or abutment. Any force applied to remove the prosthesis can damage the inner surface of the implant or fracture the screw fixation of the abutment.[5,13] The modification proposed in this article would offer the dentist the joint advantages of cemented prostheses and screw-retained prostheses in a single prosthetic rehabilitation.

Several authors[13,15,16] have described techniques for locating the screw access channel in the intermediary cemented prostheses with a perforated tab on the screw access channel place or ceramic pigmentation identifying the area access.

Rajan et al[5] and Uludag et al[17] have proposed an access channel on cement-retained implant prostheses. Bond strength test showed that screw access did not impair crown retention. As the results showed no significant difference to conventional cement-retained crowns, the use of less expensive premilled abutments with a modified cement-retained crown could be a reliable alternative treatment.

One concern in the proposed technique is whether creating screw access in a cement-retained prosthesis would influence fracture resistance. Zarone et al[2] evaluated the fracture resistance of screw-retained single metal ceramic crowns and cemented models. The authors indicated no significant difference between the 2 groups, despite cemented prostheses having shown higher resistance to fracture than screw-retained prostheses. Following similar research, Torrado et al[19] found that significantly less force was needed to fracture screw-retained crowns than cemented crowns and that the location of the access channel to the implant intermediate screw in the occlusal table did not affect the fracture resistance of the ceramic.

As the purpose of the present study was to identify whether or not the access channel interferes with retention, no veneering porcelain was added to the cast metal. To prevent porcelain fracture, metal casts should be designed to provide complete porcelain support within the screw channel. Other limitations were that specimens did not represent the clinical shape of cast metal and the effects of aging and cyclic loading on retention were not evaluated. Thus, further long-term studies are needed to evaluate biomechanical behavior and the clinical application of this technique.

CONCLUSION

Within the limitations of this study, the following conclusions were drawn:

1. There was no significant difference between the conventional cement-retained crown and screw-channel modified crown regarding the bond strength.
2. The placement of a screw access channel did not reduce crown retention.

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