Short Communication

Fracture Resistance of Metal- and Galvano-Ceramic Crowns Cemented with Different Luting Cements: In Vitro Comparative Study

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This study aimed to compare the fracture resistance of galvano-ceramic crowns with metal-ceramic crowns cemented to natural premolar teeth with different luting cements. Sixty intact maxillary premolars were prepared to receive full-coverage crown restorations and were divided into 2 equal groups (n = 30): galvano-ceramic crowns and metal-ceramic crowns. Each group was further subdivided into 3 equal subgroups (n = 10) according to the luting cement used: zinc-phosphate, glass-ionomer, or adhesive-resin cement. The specimens were then compressively loaded until failure in a universal testing machine. The metal-ceramic crowns exhibited higher resistance to fracture compared to galvano-ceramic crowns, but both exceeded the normal documented values of occlusal masticatory forces. *Int J Prosthodont 2006;19:610–612.*

In an attempt to obtain a system less susceptible to failure, the galvano-ceramic technique was introduced to obtain a metal framework with the great advantage of completely eliminating casting steps.[1]

Fracture resistance is an important criterion for long-term success and depends on many factors, including the luting agent and the type of metal, which has to withstand normal occlusal forces.[2,3]

The purpose of this study was to compare the fracture resistance of galvano-ceramic crowns with that of widely used metal-ceramic crowns after they were cemented to natural premolar teeth with different luting cements.

Materials and Methods

Grouping

Sixty sound extracted maxillary premolars were centrally embedded in polyvinyl chloride rings filled with self-curing acrylic resin, and then classified randomly into 2 groups of 30 teeth each according to the type of restoration that they received: galvano-ceramic or metal-ceramic crowns.

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Each group was then subdivided into 3 subgroups of 10 teeth each according to the luting cement used: zinc-phosphate, glass-ionomer, or adhesive-resin cement.

Teeth Preparation

Using an industrial lathe machine (BV Series Bench Lathe, Ningbo), all teeth were subjected to standardized crown preparation[4] of 1.5-mm axial and 2-mm occlusal reduction, and a deep chamfer 1 mm in width above the cementoenamel junction.

Impressions

All prepared premolars were reproduced using an addition silicon impression material (Swiss Tec, Coltene Whaledent) according to the 2-step impression technique. The molds were poured with improved die stone (DYNAROCKxr, DFS) according to the manufacturer's instructions.

Coping Fabrication

Thirty reproduced working dies were prepared for gold electroforming by attaching the electroforming head (AGC MICRO, Wieland Dental) with the occlusal surface pointing in a clockwise direction, thus making the ion flow of the electrolytic solution counterclockwise. The electric current passed through the electrolytic solution, depositing gold ions over the silver-coated working dies, thus forming a coping. Next, the outer surface of

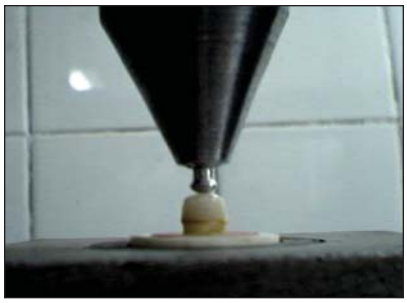

Fig 1 *(left)* The cemented crown fixed to the lower jig and the round tip secured to the upper jig of the universal testing machine.

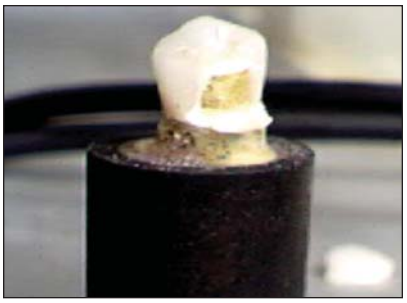

Fig 2 *(right)* Galvano-ceramic crown after partial fracture of the ceramic veneer.

Table 1 Effect of the Different Luting Cements on Fracture Resistance (N) Within Both Groups (One-Way Analysis of Variance)*

	Zinc phosphate	Glass ionomer	Adhesive resin	Overall	F	*P*
Metal-ceramic	1119.20[b] ± 294.28	1169.20[b] ± 263.33	1503.80[a] ± 290.97	1264.07[a]	5.45	.0103
Galvano-ceramic	381.0[b] ± 73.09	420.70[b] ± 55.97	558.00[a] ± 67.73	453.23[a]	19.81	.0001

*Values with the same superscript letter are not significantly different.

the copings was sandblasted with 50-μm aluminum oxide, followed by painting with a thin layer of bonding material in preparation for ceramic veneering, according to the manufacturer's instructions.[5]

The remaining 30 dies were prepared for metal-ceramic crowns using nickel-chromium dental alloy (Niadur, DFS).

Ceramic Layering

After application of a thin opaque layer for all prepared teeth, ceramic layering was performed using a low-fusing ceramic according to the manufacturer's instructions. The restoration dimensions were verified to a final thickness of 2 mm.

Luting Procedure

The crowns were cemented with zinc-phosphate (Flecks, Mizzy), glass-ionomer (Ketac-Cem, ESBE), or adhesive-resin cement (Bistite II, DC).

Fracture Resistance Measurements

All 60 specimens were compressively loaded along their long axis with a steel sphere 4 mm in diameter attached to the upper moving head of the universal testing machine (Fig 1), at a crosshead speed of 1 mm/minute, until fracture occurred (Fig 2).

Results

One-way analysis of variance (Table 1) indicated differences between the luting cements within groups ($P = .0103$ and .0001 for the metal-ceramic and galvano-ceramic groups, respectively). The fracture resistance values of the crowns cemented with adhesive resin in both groups were significantly different (least significant difference = 259.78 and 60.553 for the metal-ceramic and galvano-ceramic groups, respectively) compared to the crowns cemented with zinc phosphate or glass ionomer. No difference in the fracture resistance values was documented between the zinc-phosphate or glass-ionomer cement in either group.

Student *t* tests comparing the fracture resistance values of the same luting cement within the different groups indicated a statistically significant difference ($P < .0001$) for the 3 cements. The higher values were recorded for the traditional metal-ceramic crowns, regardless of the cement type (Table 2).

Discussion

Fracture resistance for crowns cemented with adhesive resin in both groups was significantly higher than the crowns cemented with zinc phosphate or glass ionomer. This finding could be attributed to the greater chemo-mechanical bonding between the adhesive resin and both metal alloys.

The fracture resistance data showed that the metal-ceramic crowns had a greater resistance to fracture compared to galvano-ceramic crowns. The elastic modulus of the nickel-chromium substructure is 20,000 N/mm^2, while that for gold is 11,200 N/mm^2. This could play an important role regarding the results, as the rigid metal support minimizes the deflection of the brittle ceramic veneers. Moreover, the presence of the chemical bond provided via the metal-oxide film could also help strengthen the ceramic material. However, both crown systems possessed fracture resistance exceeding normal occlusal masticatory forces recorded at the premolars (263 N and 243 N for men and women, respectively).[3]

Table 2 Fracture Resistance Load (N) of Both Crown Systems When Cemented with the Same Luting Cement (Student *t* Test)*

	Zinc phosphate	Glass ionomer	Adhesive resin
Metal-ceramic	1119.20[a] ± 294.28	1169.20[b] ± 263.33	1503.80[c] ± 290.97
Galvano-ceramic	381.0[a] ± 73.09	420.70[b] ± 55.97	558.00[c] ± 67.73
t	7.69	8.79	10.01
df	18	18	18
P	.0001	.0001	.0001

*Means with the same superscript letter are not significantly different.

Conclusions

Within the limitations of this study, the following can be concluded:

1. The fracture loads of the 2 tested crown systems exceeded the recorded values of normal occlusal forces.
2. The metal-ceramic crowns exhibited higher fracture resistance than galvano-ceramic crowns, regardless of the luting cement used.
3. The type of cementing material significantly affected the fracture resistance of both crown types.
4. Galvano-ceramic crowns cemented with an adhesive resin exhibited higher fracture resistance those cemented with either zinc-phosphate or glass-ionomer cement.

References

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Literature Abstract

Prevalence of obstructive sleep apnea following head and neck cancer treatment: A cross-sectional study

The purpose of this clinical study was to determine the prevalence of obstructive sleep apnea (OSA) within a Dutch population treated for head and neck cancer at the same center. All patients who were seen in the Department of Oral and Maxillofacial Surgery of the University Medical Center Groningen from May to October 2004 for regular follow-up exams (at least 6 months) after treatment of T2N0M0 or higher only for primary oral/oropharynx carcinoma were eligible to participate in the study. Patients with tracheostomy were also excluded. Forty-nine patients met the criteria and 33 patients (23 men and 10 women) responded to the study, with an age range from 38 to 87 years. Patients who showed an Epworth sleepiness scale of 10 or more, which is consistent with excessive daytime sleepiness, were considered to have OSA-related complaints (10 patients). These patients were then asked to have a sleep test (polysomnography). Two patients refused and 1 patient had a recurrence prior to the polysomnography. Four patients were found to have an apnoea-hypopnoea index of 5 or more, which is considered as having OSA. Within the limitations of this pilot study at a single site in The Netherlands, the prevalence of OSA was 12%. The authors' suggest that all patients treated with an oral or oropharynx carcinoma with a minimum stage T2 be screen for OSA.

Nesse W, Hoekema A, Stegenga B, van der Hoeven JH, de Bont LGM, Roodenburg JL. *Oral Oncology* 2006;42:107–113. **References:** 22. **Reprints:** Dr Willem Nesse, Department of Oral and Maxillofacial Surgery, University Medical Center Groningen, University of Groningen, PO Box 30 001, 9700 RB Groningen, The Netherlands. E-mail: w.nesse@kchir.umcg.nl—*Alvin G. Wee, OSU College of Dentistry, Columbus, OH*