Short Communication

Retention of Gold Alloy Crowns Cemented with Traditional and Resin Cements

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The aim of this study was to measure in vitro retention of cast gold crowns cemented with traditional and resin cements. Forty-eight human molars were prepared on a lathe to produce complete crown preparations with a consistent taper and split into six groups, eight crowns in each group. Crowns were cast in a high-gold alloy and then cemented. After 24 hours, the retention force (N) was recorded and mean values were analyzed by one-way analysis of variance and the Fisher post-hoc least significant difference (PLSD) multiple comparisons test (α = .05). Failure sites were examined under ×100 magnification and recorded. Mean values (SD) for each group in increasing order of retention force were: Harvard Cement: 43 N (27), TempoCem: 59 N (16), PermaCem Dual: 130 N (42), RelyX Luting Cement: 279 N (26), Contax and PermaCem Dual: 286 N (38), and TempoCem with Contax and PermaCem Dual: 340 N (14). The Fisher PLSD interval (P = .05) for comparing cements was 29 N. Zinc-phosphate cement and provisional resin cements had the lowest retention forces. Resin cement with a bonding agent and the hybrid-ionomer cement had similar retention forces. Resin cement with a bonding agent applied after use of a provisional resin cement had a significantly higher retention force than the other cements tested.
Int J Prosthodont 2009;22:351–353.

A metal crown requires adequate retention and resistance to ensure clinical success. Factors such as wall parallelism, preparation length, taper, and surface area can affect the retention of metal crowns.[1,2] Various clinical techniques can improve retention and resistance. Increasing the length of the axial walls of the preparation, preparing the axial surface to within 2 to 5 degrees parallel to the opposing walls, and increasing the surface area of the preparation all contribute to improving retention and/or resistance values of a crown.[2,3] Aging has been shown to decrease the retentive properties of traditional cements.[4] Increases in the powder-to-liquid ratio with some cements have been shown to increase the consistency of the cement and to provide greater retention[5]; however, the increased consistency can affect the film thickness of the cement.

The purpose of this study was to measure the retentive strength of complete metal crowns cemented with various traditional and resin cements. The null hypothesis was that there was no difference in retentive strength among the cements tested.

Materials and Methods

Forty-eight noncarious human maxillary and mandibular molars were prepared on a lathe with a 3.0-mm diamond wheel (HP-9002, Brasseler) attached to an

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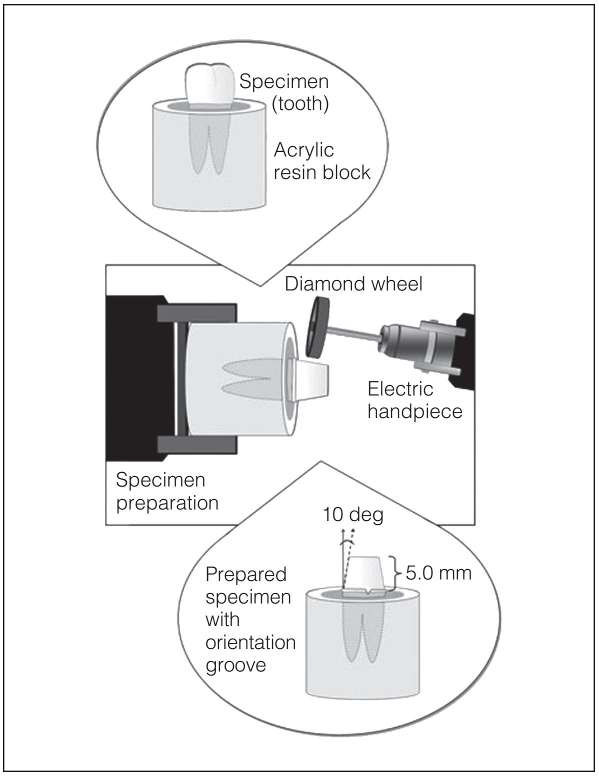

Fig 1 Schematic drawing showing preparation of the tooth.

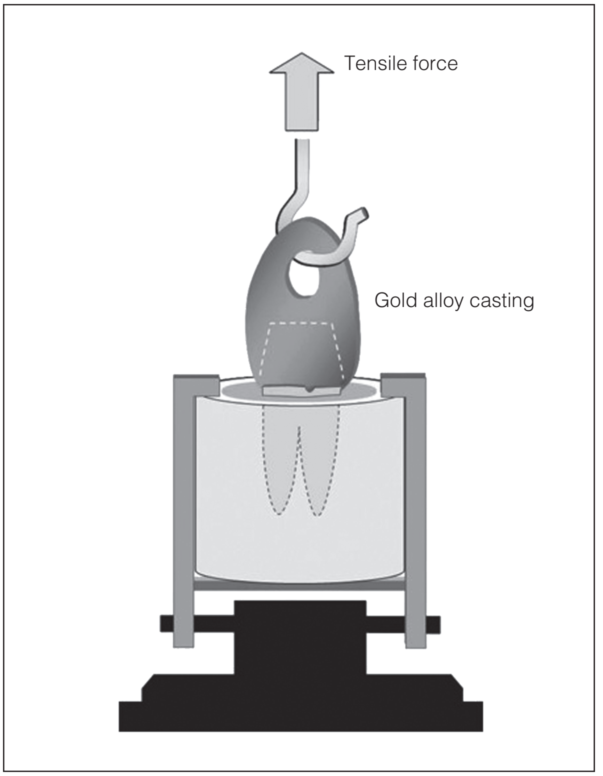

Fig 2 Schematic drawing showing debonding of the crown on the tooth.

electric handpiece (XL30W, Osada Electric) to produce consistent taper and dimensions (20 degrees total, 5.0-mm axial height) (Fig 1). An orientation groove was placed into the facial shoulder of each preparation to ensure proper seating orientation of the crown on the preparation (Fig 1). Surface area of the teeth was not determined. The crowns with a loop were cast in a high-gold alloy (Argenco 2, Argen Corp). The cast intaglio surfaces were microetched (Microetcher ERC, Danville Engineering and Materials) with 50-µm aluminum oxide (Comco) at 40 psi at a distance of 6 to 8 mm from the surface for approximately 5 seconds per specimen.

Crowns were cemented with cements mixed according to manufacturers' instructions. Six groups (n = 8 for each group) of varying cements comprised this study: Harvard Cement (Harvard Cement), TempoCem (DMG), PermaCem Dual (DMG), RelyX Luting Cement (3M ESPE), Contax (DMG) with PermaCem Dual, and TempoCem with Contax and PermaCem Dual. A layer of mixed cement was applied onto the internal aspect of each crown, and each crown was seated axially with strong finger pressure. Excess cement was removed from the margins. The specimens were stored in distilled water at 37°C for 24 hours before testing.

Specimens were subjected to tension using a universal testing machine (Model 4465, Instron) at a cross-head speed of 0.5 mm/minute (Fig 2). The force at which retention failed was recorded in Newtons (N). Failures were classified under ×100 magnification.

Mean values and standard deviations of retention forces were calculated. Data were analyzed by one-way analysis of variance (ANOVA) (StatView 5.0, SAS Institute). Mean values were compared using the Fisher post-hoc least significant difference (PLSD) multiple comparisons interval ($\alpha = .05$) and data regarding failed cements were not analyzed statistically.

Results

Mean values and standard deviations of retention forces for the six groups are listed in Table 1. One-way ANOVA indicated significant differences among the cements. The Fisher PLSD interval for comparing retention forces between any two cements was 29 N. The cements were ranked in order of increasing retention force as: HC (43 ± 27 N) = TC (59 ± 16 N) < PC (130 ± 42 N) < RX (279 ± 26 N) = PC/C (286 ± 38 N) < TC/PC/C (340 ± 14 N). Failure modes were mixed (Table 1).

Discussion

The null hypothesis of this study was rejected because there were significant differences in retention forces among the cements tested. A possible reason for the increase in the crown retention strength after the application of Contax might be the chemical compatibility between the bonding agent (C) and the cement (TC). Furthermore, it could be speculated that this self-etching bonding agent (C) created adhesion conditions on the interface surface due to the acidic monomer interaction with the dentin substrate followed by the bonding penetration in the dentinal tubules, resulting in the improvement of the adhesion of the cement to the dentin substrates.

Limitations of this experiment include finger pressure variability at the time of cementation, not accounting for specimens with variable surface areas, limiting comparison to other studies, and no thermocycling or dynamic fatigue testing.

Table 1 Mean Retention Forces (Standard Deviations) and Types of Failure of Crowns Bonded with Traditional and Resin Cements

Cement*	Retention force (N)†	Types of failure (%)
Harvard Cement (HC)	43 (27)[a]	A–58 C–42
TempoCem (TC)	59 (16)[a]	A–91 C–9
PermaCem Dual (PC)	130 (42)	A–100
RelyX Luting Cement (RX)	279 (26)[b]	A–9 C–66 R–25
Contax and PermaCem Dual (PC/C)	286 (38)[b]	A–84 C–16
TempoCem and Contax and PermaCem Dual (TC/PC/C)	340 (14)	A–70 C–5 R–25

A = adhesive failure, C = cohesive failure in the cement, R = cohesive failure in the root.
*n = 8 for each group.
†Means with the same superscripted letter were statistically the same.

Conclusions

Harvard Cement and TempoCem had the lowest retention forces. PermaCem Dual and RelyX Luting Cement had statistically the same retention force. PermaCem Dual with Contax applied after the use of TempoCem demonstrated a significantly higher retention force than the other cements tested.

References

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Erratum

In IJP issue 3, 2009, in the article by Dr Terry R. Walton, the legends in Figures 1, 3, and 5 were switched. The light gray data should correlate to the year 1998 and the black data to the year 2006. The online version of this paper has been corrected. The publisher regrets this error.