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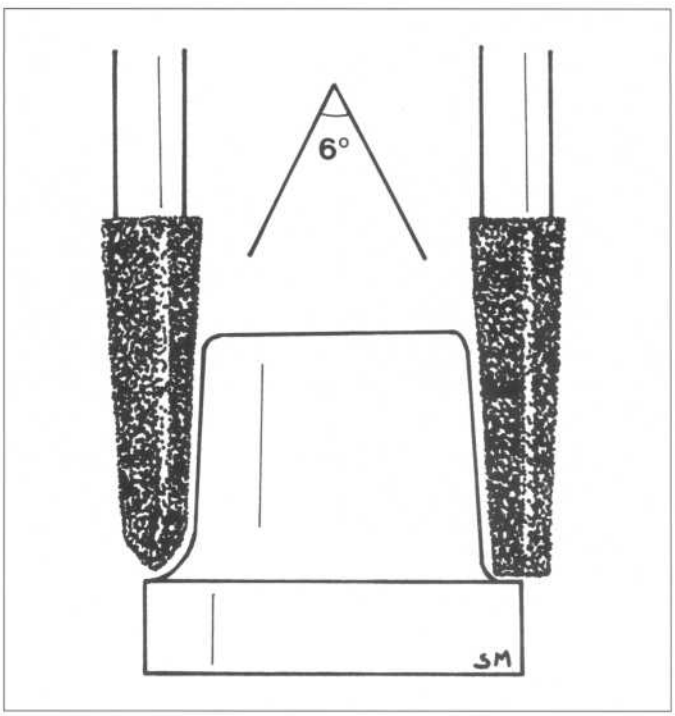
PROSTHODONTICS™

NEWSLETTER

SPRING 2005

IN THIS ISSUE:

Do you or your staff have any questions or comments about **Prosthodontics Newsletter**? Please write or call our office. We would be happy to hear from you.



An in vitro study measured vertical marginal discrepancies for 3 different all-ceramic crown coping systems when cemented with 3 different cements to machined metal dies that possessed either a chamfer or shoulder finish line. (See *Finish Lines and Luting Agents With Various Ceramic Copings,* inside.)

Materials and Techniques Used in Fixed Prosthodontics: An Update

Prosthodontic materials and techniques that appear innovative may not produce the desired results when applied clinically. In vitro studies help to clarify the mechanical properties and behavior of new materials and methods, alerting dentists, manufacturers and researchers to potential problems in vivo. This issue of *Prosthodontics Newsletter* reviews recent in vitro studies related to materials and techniques used in fixed prosthodontics.

Finish Lines and Luting Agents with Various Ceramic Copings

All-ceramic crowns have become more popular in everyday dentistry, and there are a variety of all-ceramic systems currently available to the dentist. An in vitro study by Quintas, a private practitioner from São Paulo, Brazil, et al, evaluated the effects of 2 different finish lines, 3 cements and 3 commercially available all-ceramic systems on the vertical marginal gaps of ceramic copings.

Two stainless-steel molar crown preparations were made. Both preparations possessed a 6° convergence angle. The only difference between the 2 preparations was the geometry of their finish lines (heavy chamfer and rounded shoulder; cover illustration). A notch was prepared to ensure repeatable seating of the copings (Figure 1). The investigators produced 180 type-IV stone dies and 180 ceramic copings (60 for each all-ceramic system) and divided these specimens into 18 groups.

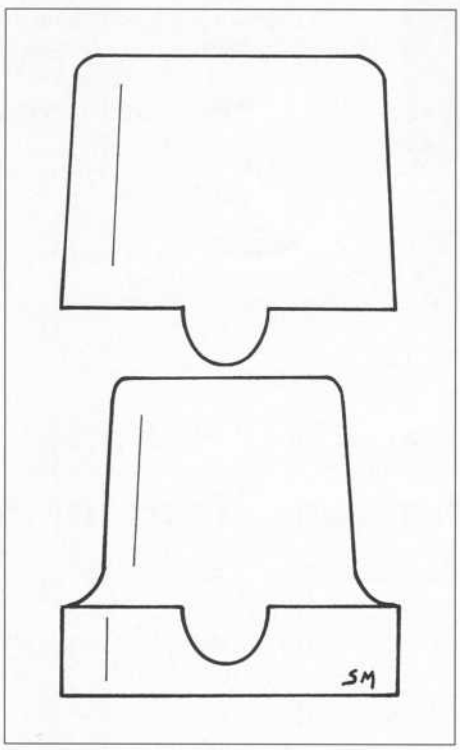


Figure 1. A notch below the finish line ensured repeatable seating of the copings.

The 3 all-ceramic systems investigated were the IPS Empress 2 lost-wax system (Ivoclar Vivadent), the InCeram slip-cast technique (Vita Zahnfabrik) and the Procera alumina coping method (Nobel Biocare). The 3 cements used in the experiment were zinc phosphate cement (SS White Artigos Dentários), resin-modified glass ionomer cement (Fuji Plus; GC America) and resin composite cement (Panavia F; J Morita USA).

With the use of a metal frame that maintained forces parallel to the long axis of the tooth, each coping was cemented to its respective metal tooth preparation. Before and after cementation of the copings, the distance between the margin of each coping and the finish line of the metal tooth preparation was measured between 2 predetermined points.

Results indicated superior performance for the Procera copings, regardless of the combination of finish line or cement. Mean marginal gaps for Procera copings before and after cementation were 25 µm and 44 µm, respectively. Before and after measurements for Empress 2 copings and InCeram copings were 68/110 µm and 57/117 µm, respectively. The ceramic system was the primary factor that influenced the size of the mean marginal gaps. The type of finish line was not statistically significant for most groups, and the type of cement was not significant.

Comment

The marginal gaps reported for the Procera system are exceptionally good, while the results reported for the other 2 systems are less encouraging. Although none of the other variables influenced the results, it should be noted that some combinations of variables evaluated in this study are not recommended by the manufacturers of the materials and techniques studied.

For example, the Procera system advises against a right-angled shoulder finish line because this geometry is difficult to read with the Procera scanner. The Empress 2 system advocates the use of an adhesive resin cement and does not recommend zinc phosphate cement or resin-modified glass ionomer cement. The manufacturer of Fuji Plus cement recommends this cement for Procera crowns only, not for the other 2 ceramic systems.

Quintas AF, Oliveira F, Bottino MA. Vertical marginal discrepancy of ceramic copings with different ceramic materials, finish lines, and luting agents: an in vitro evaluation. J Prosthet Dent *2004;92:250-257.*

Effects of Fatigue Loading On Post-and-core Restorations

Most failures of post-and-core restorations in vivo appear to be the result of dynamic loading and fatigue failure. Conventional cements are popular for cementation of posts, but cyclic occlusal loading may cause these cements to degrade over time. A study by Bolhuis et al from the Academic Centre for Dentistry Amsterdam, the Netherlands, com-

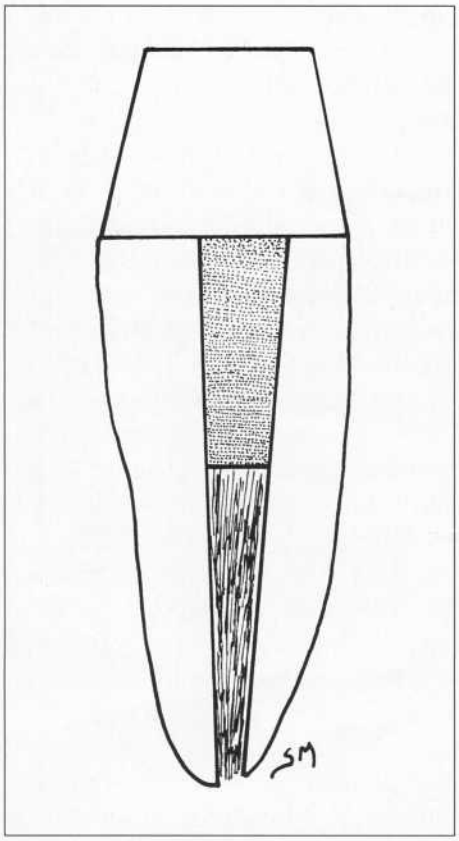


Figure 2. Cores were 5 mm in height and posts were 6 mm in length. Forces were applied directly to the cores at an angle almost perpendicular to the long axis.

pared the effects of fatigue loading on the performance of cast posts and cores cemented with conventional zinc phosphate cement and an adhesive resin cement.

Extracted premolars with their crowns amputated were endodontically treated and then prepared for cast posts and cores. A simulated periodontal ligament was prepared around the roots, which were embedded in acrylic-resin cylinders. Half the posts ($n = 8$) were cemented with zinc phosphate cement (PhosphaCem/C; Ivoclar Vivadent) and half ($n = 8$) were cemented with adhesive resin cement (Panavia 21; Kuraray).

Half the specimens ($n = 4$) in each cement group were dynamically loaded for 1,000,000 cycles at an angle 85° to the long axis of the post with alternating loads of 8 N and 40 N. The remaining halves from both groups ($n = 4$) were unloaded and served as controls.

Three consecutive 1.5-mm sections were cut from all 16 specimens. For each section, the integrity of the cement film surrounding the post was evaluated under scanning electron microscopy, and retentive strengths of the cemented post sections were measured with a push-out test.

Results indicated significantly more irregularities in the cement film with the zinc phosphate cement, but fatigue loading did not degrade the retentive strengths for either cement type.

Comment

In this experiment the posts were only 6 mm in length, and the specimens lacked a cemented crown with circumferential ferrule. Loads were applied directly to the cores for 1,000,000 cycles and at an angle that was almost perpendicular to the long axes of the posts (Figure 2).

Nevertheless, the authors were unable to demonstrate a reduction in the retentive capacity of either cement despite the extremely harsh cyclic loading conditions. Although it is impossible to predict precisely the clinical behavior of these 2 cements based solely on the outcome of this in vitro study, these results suggest that conventional zinc phosphate cement can be used effectively for cast posts.

One limitation of this study is the small sample size (only 4 specimens for each subgroup). Also, specimens were dynamically loaded but were not thermocycled. Combining cyclic loading with thermocycling can more closely mimic clinical conditions in vitro.

Bolhuis HP, de Gee AJ, Pallav P, Feilzer AJ. Influence of fatigue loading on the performance of adhesive and nonadhesive luting cements for cast post-and-core buildups in maxillary premolars. Int J Prosthodont *2004; 17:571-576.*

Cementing Agents for Fixed Prosthodontics

A study by Piwowarczyk et al from Johann Wolfgang Goethe University, Germany, measured the shear-bond strengths of various cements when used to lute resin composite cylinders to high-gold dental alloy (Targis Gold; Ivoclar/Williams), high-strength aluminum-oxide porcelain (Procera AllCeram; Nobel Biocare), leucite-reinforced porcelain (IPS Empress; Ivoclar Vivadent) and lithium disilicate porcelain (IPS Empress 2; Ivoclar Vivadent).

Eleven different brands of cement were studied. The types of cements used included zinc phosphate, glass ionomer, resin-modified glass ionomer and dual-polymerizing resin cements. Shear-bond strengths were measured with a universal-testing machine.

Half the specimens ($n = 10$) were tested 30 minutes after cementation, and the remaining half were stored for 14 days in distilled water followed by thermocycling 1000 times. Results indicated that after 14 days of water storage and thermocycling, only RelyX Unicem (3M ESPE), Panavia F (Kuraray) and Compolute (3M ESPE) resin cements maintained a strong bond to the materials tested.

Zinc phosphate, glass ionomer

and resin-modified glass ionomer cements recorded low bond strengths after the 14-day storage and thermocycling, with some specimens spontaneously debonding. None of the cement types produced the highest bond strengths for all restorative materials tested.

Comment

The cement that appeared to produce the best overall results was RelyX Unicem cement. This relatively new cement is a self-adhesive, dual-polymerizing resin cement. The manufacturer claims that the cement will bond to tooth structure without etching, priming or bonding procedures, and results of this study suggest this cement could be expected to produce a durable bond with all of the restorative materials tested.

Piwowarczyk A, Lauer H-C, Sorensen JA. In vitro shear bond strength of cementing agents to fixed prosthodontic restorative materials. J Prosthet Dent 2004;*92:265-273.*

Effect of Sulcular Width On the Accuracy of Impression Materials

Finish lines for complete crowns are commonly located within the gingival sulcus. An accurate impression of the finish line requires adequate gingival displacement to allow the impression material to flow into the sulcus and to prevent distortion of the impression when it is removed from the mouth.

A study by Baharav et al from Tel Aviv University, Israel, evaluated the effect of sulcular width on the accuracy of dies poured from various dental impression materials. Six metal dies that simulated tooth preparations for complete crowns were made. The dies were machined with a chamfer finish line and an undercut apical to the chamfer.

The 6 dies were identical except for the troughs that represented the gingival sulci, which were 0.10 mm, 0.15 mm, 0.20 mm, 0.25 mm, 0.30 mm and 0.40 mm in width. Impressions were made with Express polyvinyl siloxane (3M), Examix polyvinyl siloxane (GC), Elite polyvinyl siloxane (Elite), Permadyne polyether (ESPE-Premier) and Permlastic polysulfide (Kerr/Sybron) impression materials. Ten impressions were made of each die with each brand of impression material.

Impressions were poured in type-IV gypsum (Silky-Rock; Whip Mix). The diameter of each stone die was measured 4 times with a toolmaker's microscope, and a mean was calculated for each specimen. The percent distortion of each stone die compared with the metal master die was calculated.

Results indicated that distortions ranged from 0.01%–0.89%. Distortion was greatest with the 0.10-mm sulcular width, ranging from 0.43%–0.89%. When the width of the sulcus was ≥0.15 mm, the amount of distortion was significantly less and within a clinically acceptable range.

Comment

All dies in this study recorded some distortion, but distortion was much higher with the narrowest sulcular width. The recorded distortion with the 0.10-mm sulcus would produce marginal inaccuracies at the finish line ranging from 41 µm–86 µm. This error, combined with other inevitable errors in the fabrication process for complete crowns, would likely have clinical relevance.

Sulcular widths ≥0.15 mm resulted in an absolute distortion in the diameter of the stone dies of approximately 20 µm, a value unlikely to produce clinically relevant marginal inaccuracies.

Baharav H, Kupershmidt I, Laufer B-Z, Cardash HS. The effect of sulcular width on the linear accuracy of impression materials in the presence of an undercut. Int J Prosthodont *2004;17:585-589.*

NEXT:

- Orofacial pain and occlusion
- All-ceramic fixed partial dentures
- The shortened dental arch

Our next report features a discussion of these issues and the studies that analyze them, as well as other articles exploring topics of vital interest to you as a practitioner.